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CONTENTS

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CORRECTIONS

MONTHLY WEATHER REVIEW, January 1949, volume 77, page 16: In "River Stages and Floods" the third sentence of the second paragraph should read, "The floods in southeastern Indiana were generally the greatest since 1943 and the highest since 1913 on the East Fork of the White at Seymour, Ind."

Page 17 under heading Ohio Basin: Line 9 of paragraph 7 should read, "along the East Fork and main White," instead of "along the East Fork and main branches of the White"; line 15 of paragraph 7 should read "over the lower East Fork and White Rivers" instead of "over the lower East Fork and main branch of the White"; in line 20 of paragraph 7 the monthly total for Petersburg, Ind., should be 15.96 inches instead of 15.51.

Page 18: In table 2 the river stage for Seymour, Ind., under heading "March or May 1943" should read "18.8" instead of "19.8."

Page 26: In table of "Severe Local Storms for January 1949," storm areas in North Dakota, January 1–31 should be north-central and southwestern portions instead of southeastern; storm damage in Illinois has been revised from the $305,000 previously reported to $775,000.

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AN OBJECTIVE METHOD OF FORECASTING RAIN IN CENTRAL CALIFORNIA DURING THE RAISIN-DRYING SEASON

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THE PROBLEM

Forecasting rain for raisin-drying areas in the San Joaquin Valley of central California long has been a problem of major economic importance [1]. The raisin crop grown and processed in this area is valued at millions of dollars annually.[1] During the late summer and early fall season, when the raisin grapes are dried in the open, unexpected rainfall amounts in excess of a few hundredths of an inch will adversely affect the exposed grapes. Raisin grapes are dried either on trays or on paper, and when rain threatens, growers stack the trays or roll the papers to protect the drying fruit. The expense involved in carrying out these protective measures is such that they cannot be undertaken unless a loss to the crop is threatened.

The vital importance of forecasting rain for these areas led to the investigation which is reported in this paper. Its objective was to determine the value of a number of meterological variables commonly used in preparing precipitation forecasts for the area during this season and to discover, if possible, combinations of the variables which have definite forecasting possibilities. The approach to a rain forecasting problem developed by Brier [2] was used to advantage.

GENERAL ASPECTS

In this investigation, several general aspects of the problem were considered before the development of an objective procedure was undertaken. They included (*a*) topographic and climatic influences which make forecasting rain for the San Joaquin Valley a unique problem; (*b*) rainfall frequency at Fresno, a knowledge of which is helpful in establishing the most critical periods of the season; (*c*) choice of forecast periods which must be adjusted to the growers' needs and to the observation times; and (*d*) data which were available for use in the study.

TOPOGRAPHIC AND CLIMATIC INFLUENCES

Forecasting rainfall in the Valley is a unique problem since that area is in a rain shadow for storms approaching from any direction except the north. Directly to the east are the Sierra Nevada Mountains; to the south, the Tehachapis; and to the west, the coast range. (See fig. 1.) In addition, storms approaching from the north must first pass over the mountains in the northern portion of the State, and they are subsequently affected by a disrupting influence in passing southward through the Great Interior Valley comprised of the Sacramento and San Joaquin Valleys. Thus, rainfall may occur in heavy amounts in surrounding mountains, mainly in the high Sierras, with little or none reaching the floor of the Valley.

Because of the existence of the rain shadow in this forecast area, rainfall due to frontal action is of negligible importance unless associated with convergence at intermediate levels aloft. Except for areas in the foothills—which are almost wholly out of the raisin-drying region—rainfall

FIGURE 1.—Relief map of California showing rainfall stations in the San Joaquin Valley used in this study.

[1] The value of the 1946 raisin crop has been estimated at about 55 million dollars, with almost the entire crop exposed to the weather at the peak of the drying season. Although no loss occurred in 1946, losses to the drying crop from unexpected heavy rainfall have been as high as 20 percent in the past, with a loss of almost 100 percent possible.

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due to orographic lifting is also negligible. In seeking meteorological indices capable of producing worthwhile results in forecasting, it was therefore necessary to place the main emphasis on variables other than those involving frontal and orographic effects. In general, it was necessary to get some indication of the convergence in low and intermediate levels, together with temperature and moisture measurements.

Complications are introduced into the forecast problem due to the proximity of the forecast area to the ocean, to the marine climate in coastal sections, and to the desert climate to the east of the Sierras and to the south of the Tehachapis. Although the Valley is protected from a direct marine influence by the coastal range of mountains, modified marine air is continually feeding in through the break in the coast range in the vicinity of San Francisco Bay and to a lesser extent from the west directly over the coast range. Because of the presence of the modified marine air in the lower levels of the atmosphere, surface moisture is not representative of the moisture through a deep layer.

An additional effect during the season under consideration is the marked distortion in the low-level pressure field which results mainly from two well-known factors: (*a*) the heat low of the southwest, generally centered over the Colorado River Valley, together with the commonly associated thermal trough which extends to the north-northwest through the interior of central and northern California, occasionally reaching as far north as western Oregon and Washington; (*b*) the persistent marine inversion with the underlying layer of cool marine air along the coast. Sea level pressures beneath a well-marked surface inversion may exist several millibars higher than in adjacent areas unaffected by this cool air. With the thermal low and the marine inversion well developed, surface data over the Southwestern States become nonrepresentative of developments in the upper circulation which may become sufficiently intense to produce rain. As the season progresses, however, the continental upper anticyclone becomes less predominant, and surface troughs moving into the Pacific Northwest tend to weaken the coastal inversion. Under these conditions the surface data are important meteorological indices.

RAINFALL FREQUENCY AT FRESNO

To determine the critical periods of the season, a study was made of the frequency of occurrence of measurable precipitation at Fresno, by 5-day periods for the months of September and October. The summary shown in figure 2 indicates that the rainfall occurrence by 5-day periods is about 5 percent at Fresno before September 20, but immediately thereafter it increases to about 35 percent. This sudden increase during the last decade of September may be due to a weakening and slight southward movement of the upper continental anticyclone, which allows frontal systems to encroach farther and farther southward. At the same time there may be an increase in the number of tropical storms moving northward toward the area. A decrease in heavier rains during the second decade of October is believed to be a result of the ending of the tropical storm season, although sufficient data are not available to establish this fact.

CHOICE OF FORECAST PERIODS

Forecast periods are determined by the requirements of the growers and the times that weather observations become available. In order to complete protective measures in case of a developing rain situation, growers require a minimum of 6 hours of daylight prior to the onset of rain. A forecast made at 6 a. m., P. S. T., for instance, gives them sufficient time if the rain is not to begin until afternoon. For a rain which begins during the morning hours, however, a satisfactory forecast must be issued by noon of the preceding day in order to give warning 6 hours before dark.

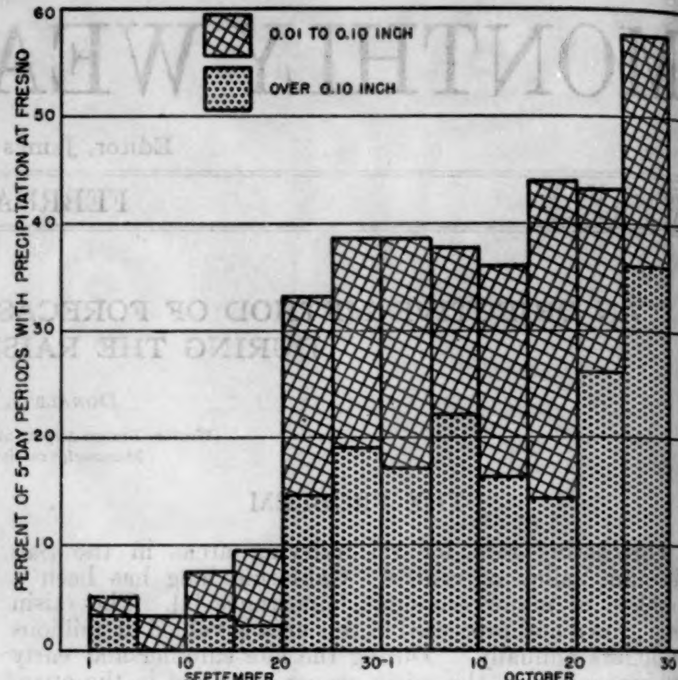


FIGURE 2.—Graph showing frequency of occurrence of measurable precipitation at Fresno by 5-day periods for the months of September and October for the period 1887 through 1945.

On the Pacific coast, upper-air data become available generally at about the 10:30 a. m. and 10:30 p. m., P. S. T., synoptic map observation times. Since current information for the upper air is essential in preparing the forecast, these times were chosen for making twice-daily forecasts. At these times available information includes 8 a. m. or 8 p. m. pilot balloon data; 7 a. m. or 7 p. m. raob data; and 10:30 a. m. or 10:30 p. m. surface observations. Since a forecast of rain within 6 hours of the time of issuance of the forecast is of little value, the period to be covered by the forecasts was chosen as 6 to 24 hours after map time. It was found that this time could be extended by requesting special telegraphic reports from raob stations, whereby necessary information could be obtained as early as 8:30 a. m. By using current surface data also (7:30 a. m., 3-hourly reports) the forecast could be prepared approximately 2 hours earlier, thus in effect changing the forecast period to 8 to 26 hours.

DATA AVAILABLE FOR STUDY

Fresno is located near the center of the raisin-drying area, and rainfall amounts occurring there and at five surrounding stations—namely, Madera, Clovis, Visalia, Lindsay, and Hanford—were used in determining the rainfall parameter. (Locations of stations are shown in fig. 1.) Of the six stations, only Fresno had an accurate record of the times of beginning and ending of precipitation. For this reason, the average total amount occurring at the six stations was adjusted as to time of occurrence in proportion to times of occurrence at Fresno.

The most critical period in the fruit-drying season, approximately from September 1 to October 15, was

chosen for the study. Prior to 1942 upper-air data were sparse, and for this reason it was impossible to extend the study back beyond that year. Satisfactory data, which were available for the years 1942 through 1947, inclusive, were used in the completed study. Because of this short record, a statistical treatment of the results of the study suffers from lack of data, a deficiency which is further emphasized by the small climatological expectation of occurrence of rain during the season under consideration. Notwithstanding these factors, the urgency of the need for a solution to this forecasting problem was such that an intensive study was deemed advisable with the available data.

CLASSIFICATION OF SYNOPTIC MAPS

The first step in developing an objective forecasting method within the limits imposed by the general aspects already considered was to devise a procedure for classifying synoptic maps on a basis determined by a study of rainfall situations.

RAIN-PRODUCING SITUATIONS

Synoptic situations which result in the occurrence of important amounts of precipitation generally fall into four different types, each of which has a characteristic upper-air distribution of pressure and temperature and a somewhat less characteristic distribution of surface data, depending upon the individual type. The four types and the characterizing features are:

Type 1.—Upper cold low over or in vicinity of area. (Not necessarily reflected clearly in surface pressures.)

Type 2.—Wave formation on nearly stationary front off coast.

Type 3.—Development of plateau low over central Nevada, generally preceded by the movement of a weak front into area.

Type 4.—Movement of decadent tropical storm toward or into area.

Mean maps for 10,000 feet during the summer and early fall show the upper-level continental anticyclone to be the dominant feature in the circulation over the western United States [3]. A fairly broad trough off the west coast separates the high-level continental anticyclone from the anticyclonic circulation above the Pacific high. Under conditions which are not fully known, but which evidently depend in part upon the wave length in the upper-air flow [4], an upper cold low will move into or form in the area off the central and southern California coast, with resulting precipitation in inland areas. This type of development results in the rain-producing situation listed under type 1. Under other conditions, the trough between the two anticyclones intensifies and moves toward the coast, allowing frontal systems to approach the area from a westerly direction, thus leading to either type 2 or type 3 of the rain-producing situations. Type 4 occurs generally with the upper continental anticyclone well developed, with southerly winds aloft favoring the movement toward the area of decadent tropical storms. As disturbances move inland with the accompanying upper trough, the winds aloft shift into a northerly direction with a rapid decrease in the probability of rain.

CLASSES OF UPPER-AIR FLOW

An inspection of the upper-air charts for the period of study shows that in general the type of rain situation which may develop depends upon the position of the forecast area with respect to the upper-air flow. Three unique classes were distinguished on the basis of the three possible positions of the area, outlined in the schematic diagram of the circulation of the 700-millibar level shown in figure 3 (a). Class I circulation may result in types 1 and 4 rain-producing situations, while class II circulation develops types 2 and 3 situations. During the existence of a class I or class III circulation, a rapid change into a class II may occur with the movement into the Pacific Northwest of a deep low pressure system. The approach of this system is first noted in the upper air by a rapid fall in the 700-millibar level at Seattle.

A study of class II charts indicated the necessity of dividing this class into two subclasses characterized by contrasting meteorological developments. With the weakening of the upper continental anticyclone toward the end of September, surges of cold air moving southward over the northeast Pacific occasionally reach south of 35° N. latitude. If the cold air moves inland into the Pacific Northwest, with pressures relatively high over the northeast Pacific, cyclogenesis usually occurs over the plateau, with lowest surface pressure over central Nevada and with the axis of the low sloping toward the northwest. However, if the main portion of the cold air remains off the coast, a broad, relatively intense trough aloft will exist from the Gulf of Alaska southward to about 30° N. latitude. with minor anticyclonic circulation above the eastern Pacific high. On the basis of these two types of upper-air flow, the cases falling into class II were subdivided into classes II_A and II_B, respectively. Upper-air flow patterns typical of these subclasses are shown in figure 11.

OBJECTIVE METHOD OF CLASSIFICATION

Following the subjective consideration of upper-air flow patterns just described, an attempt was made to develop a method whereby the classification of each situation might be designated in an objective manner based on pertinent data. Classes I and II are characterized by the existence on or near the coast of a marked trough in the upper air [indicated in figure 3 (a)]. The center of activity is to the south in a class I rain situation and to the north during a class II development. With the transition to class III, the trough aloft moves inland. The three classes were determined objectively by employing the heights of the 700-millibar level at Medford (MF), Oakland (OA), Ely (PEV), and San Diego (SQ), and the 24-hour change in height of the 700-millibar level at Seattle (SA). The position of the upper trough was defined objectively by comparing the average height at Oakland and Medford with that at Ely to distinguish between the first two and the third classes. Thus, with the average height at Oakland and Medford equal to or less than the height at Ely, the situation falls into class I or class II, while an average height at the two stations greater than that at Ely indicates class III—with the exception that a 24-hour fall of 250 feet or more in the 700-millibar level at Seattle always results in a class II designation. Classes I and II were distinguished by comparing the heights at San Diego and Ely. With the height at San Diego equal to or less than that at Ely, the situation falls into class I, with the exception noted above. With the height at San Diego greater than at Ely, the situation is placed in class II. Class II was further divided into its two subclasses, depending on the surface pressure at 45° N. latitude, and 140° W. longitude. An outline of this objective classification procedure is given in the diagram of figure 3 (b).

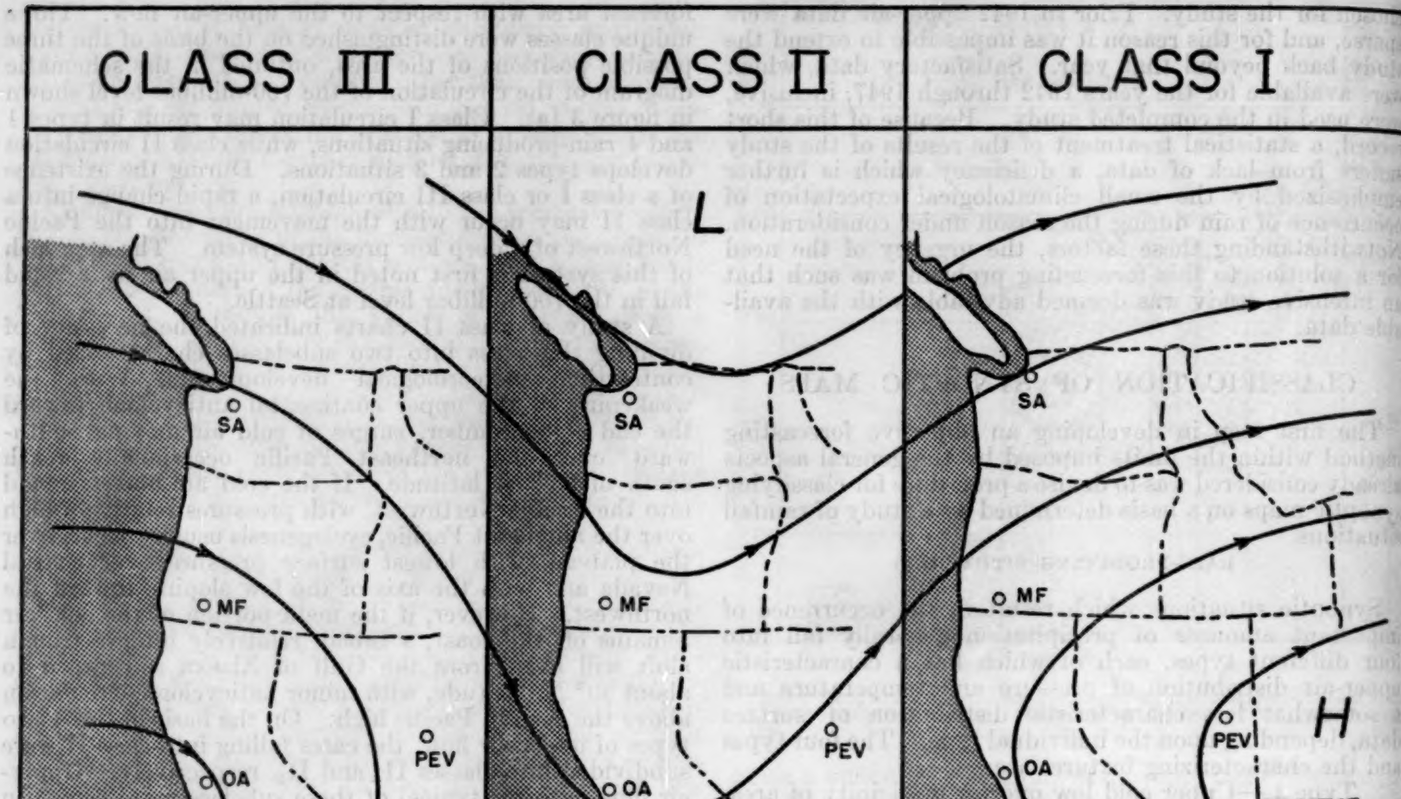


FIGURE 3 (a).—Schematic diagrams showing three possible positions of forecast area with respect to circulation at the 700-millibar level which form the basis of the three map classifications.

CHOICE AND COMBINATION OF METEOROLOGICAL VARIABLES

Following the classification of the synoptic maps, the next step in developing an objective forecasting method was to choose and combine for each class the meteorological variables indicative of rainfall. The general method of choice and combination of the variables is described below preceding the discussion of the procedure by classes.

During an exhaustive search for variables showing a definite correlation to the occurrence of rain in the area during the forecast period, a large number were tried, most of which showed a definite forecasting value. With the possible choice of variables and combinations of variables almost limitless, the number to be considered worthwhile was narrowed down by applying the knowledge of experienced forecasters. Due to the apparent interdependency of many of the variables involved in the analysis of any weather situation, the number retained to form the final forecasting procedure was kept to a minimum. Variables thus chosen were those which gave, first, the best stratification of rain and no-rain cases on a scatter diagram, and secondly, a distribution or additional stratification showing a marked tendency for heavier amounts of rainfall to occur within the area of greatest probability on the diagram. Further, they had to indicate qualitative or quantitative improvement in the final forecasting procedure.

The procedure used in preparing charts showing lines of equal probability is similar to that described by Brier [2]. The combination of two variables was accomplished by plotting values of one variable as abscissas and corresponding values of the other as ordinates on a scattergram. Each point was labeled with the amount of precipitation occurring during the forecast period, 6 to 24 hours after map time. Although precipitation amounts which are not greater than 0.10 inch in any portion of the area do not require that protective measures be taken, the occurrence of even a trace of rain indicates an exceptional situation, inasmuch as it occurs during the dry season. Furthermore, a trace during a forecast period may indicate heavier amounts to follow. For these reasons, any amount of rainfall was identified as a rain occurrence for the purposes of drawing isopleths. When there is a uniform distribution of data over the scattergram, a simple calculation may aid in the placing of isopleths. On

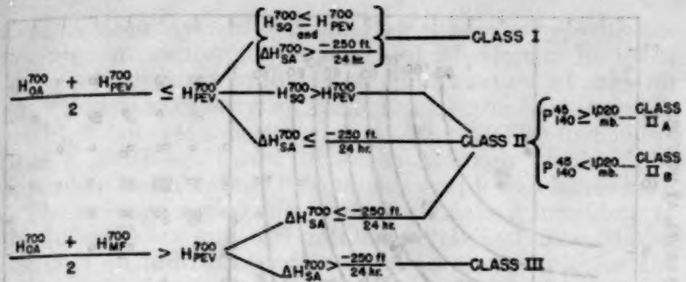


Figure 3 (b).—Schematic diagram showing procedure for objective classification of upper-air flow patterns.

the assumption that each line is to be oriented by ten points of rain or no-rain occurrences, the 100-percent line would be located by 10 rain and 0 no-rain points; the 90-percent line by 9 rain and 1 no-rain points; the 80-percent line by 8 rain and 2 no-rain points, etc. Under this supposition, 37 rain cases and 8 no-rain cases, or not quite 5 times as many rain as no-rain cases, should fall above the 60-percent line. Above the 40-percent line, the proportion is 47 to 18. Similar proportions were obtained for other isopleths. However, with the rain and no-rain cases grouped in different portions of the chart, the condition of uniform distribution was not fulfilled. In those scattergrams for which data were insufficient for the accurate drawing of isopleths, the practice was to give them equal spacing. This was true in the spacing of the 0- to 40-percent lines in figure 26 and others.

CLASS I PROCEDURE

The choice and combination of variables for the class I objective procedure were made on the basis discussed in the preceding section, after a consideration of the meteorological conditions associated with this type of upper-air flow. As indicated by the objective classification procedure outlined in figure 3 (b), the pressure distribution aloft during the existence of a class I situation results in the following 700-millibar height relationships.

$$\frac{H^{700}_{OA}+H^{700}_{MF}}{2} \leq H^{700}_{PEV}; \qquad H^{700}_{SQ} \leq H^{700}_{PEV};$$

and

$$\Delta H^{700}_{SA} > \left(\frac{-250 \text{ ft.}}{24 \text{ hr.}}\right).$$

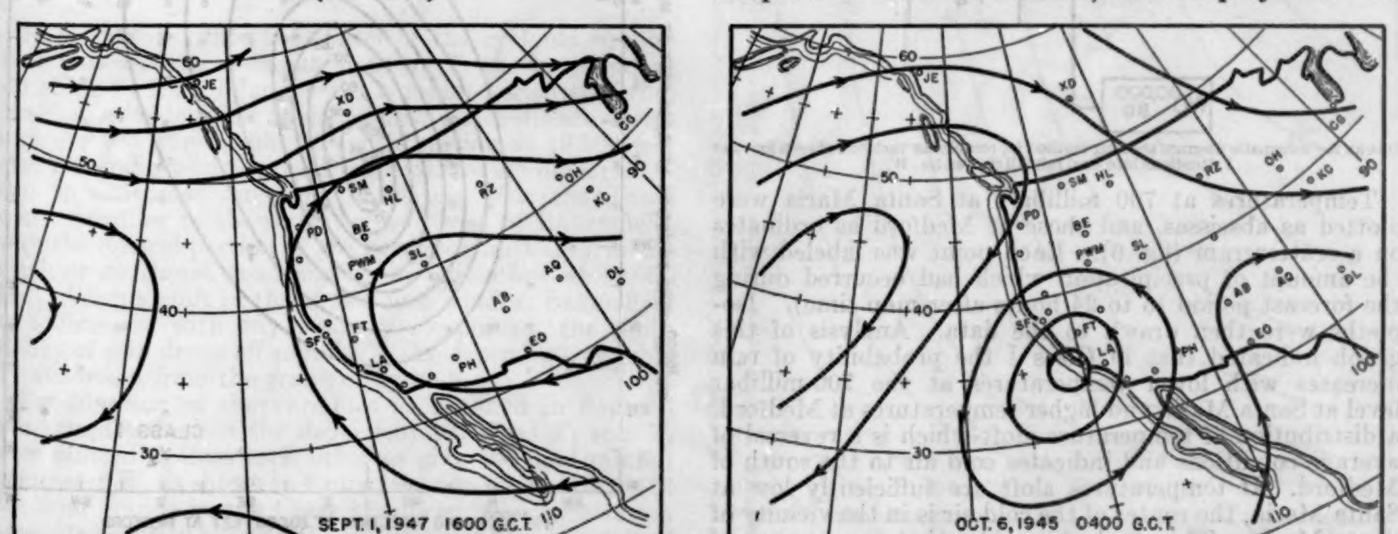
METEOROLOGICAL CONDITIONS

The most common type of upper-air flow pattern satisfying the class I criteria is that with the high-level anticyclone well developed and located in its normal position over the United States. As long as this situation prevails, no rain is possible in the area under consideration, due to the warm, dry air aloft in the western portion of the high cell. Under these conditions, temperatures at 700 millibars are generally 10° C. or higher, and the relative humidity above the moist surface layer is less than 20 percent.

The development of the most common type of rain situation in this class results when cyclogenesis occurs aloft or when an upper cold low moves into the area. In the initial stages, cyclogenesis or the movement of an upper low into the area from the south or west is often obscure due to the lack of sufficient upper-air data over Mexico and the Eastern Pacific. The first evidence of the development of a threatening rain situation in this case is noted by an increase in the speed of the winds aloft directly over the valley, with a shift to a southeasterly direction and a gradual drop in the upper-air temperature as the cyclonic circulation intensifies. With continued southerly flow, moisture is gradually brought into the circulation from lower latitudes. When cyclogenesis occurs aloft to the north or northeast, the threat of rain depends on a southward movement of the center. This movement may be followed in the upper circulation.

Still another situation may lead to rain under class I conditions. When the center of the upper-level continental anticyclone is to the south and west of its normal position, conditions become favorable for the movement of tropical storms from low latitudes toward the northwest and into the area just off the west coast of Lower California. When these storms reach a position to the west of the 120th W. meridian and to the north of 25° N. latitude, an influx of very moist tropical air into the forecast area considerably increases the probability of rain. If the tropical storm enters the coast of Lower California, the surface activity will dissipate, but the circulation aloft will continue for some time and may move into the area and cause rain over southern California.

Without regard to the initial stages of development, important amounts of rain will not occur in the forecast area until rather definite conditions of moisture and temperature aloft are attained, with deep cyclonic flow



(a) No-rain situation, with high-level anticyclone well developed and located in normal position over United States.

(b) Well-developed rain situation resulting from cold low aloft.

Figure 4.—Maps showing typical circulation patterns at 700-millibar level producing no-rain and rain situations of class I type.

centered just to the southwest of, or over, the area. Typical circulation patterns at the 700-millibar level during no-rain and rain situations in class I are shown in figure 4.

METEOROLOGICAL VARIABLES

Variables chosen for class I were confined to those involving temperature and moisture conditions aloft and the upper circulation. Independent parameters chosen were:

- T^{700}_{TZM} Temperature at 700-millibar level at Santa Maria.
- T^{700}_{MF} Temperature at 700-millibar level at Medford.
- $WD^{10,000}_{MF}$ Wind direction at 10,000 feet at Medford.
- $WD^{20,000}_{MF}$ Wind direction at 20,000 feet at Medford.
- RH^{7-500}_{ZTM} Average of the raob code figures for the relative humidity at 700-millibar and 500-millibar levels at Santa Maria.
- $WD^{10,000}_{DB}$ Wind direction at 10,000 feet at Bakersfield.

These variables were then combined to give a final rainfall parameter, W, as outlined in figure 5.

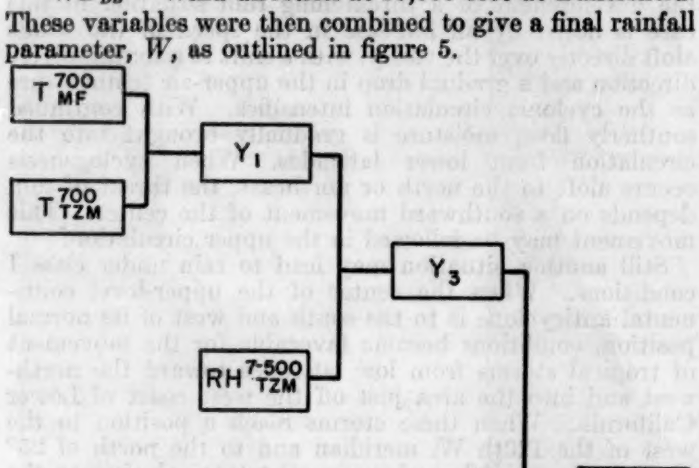


FIGURE 5.—Schematic diagram showing method for combining variables chosen for class I situations into final rainfall parameter, W.

Temperatures at 700 millibars at Santa Maria were plotted as abscissas, and those at Medford as ordinates on a scattergram (fig. 6). Each point was labeled with the amount of precipitation which had occurred during the forecast period (6 to 24 hours after map time). Isopleths were then drawn to the data. Analysis of this graph indicated that in Class I the probability of rain increases with lower temperatures at the 700-millibar level at Santa Maria and higher temperatures at Medford, a distribution of temperature aloft which is a reversal of average conditions and indicates cold air to the south of Medford. If temperatures aloft are sufficiently low at Santa Maria, the center of the cold air is in the vicinity of Santa Maria. The graph shows also that any amount of rain is unlikely with the 700-millibar temperature at Santa Maria higher than 8° C., and important amounts

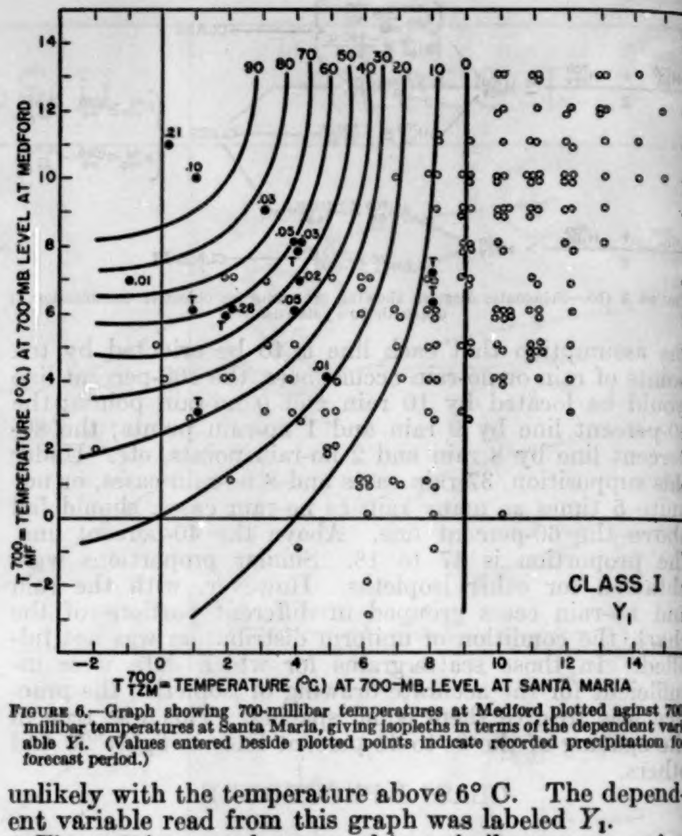


FIGURE 6.—Graph showing 700-millibar temperatures at Medford plotted aginst 700-millibar temperatures at Santa Maria, giving isopleths in terms of the dependent variable Y_1. (Values entered beside plotted points indicate recorded precipitation for forecast period.)

unlikely with the temperature above 6° C. The dependent variable read from this graph was labeled Y_1.

Figure 7 is a graph prepared in a similar manner using variables in which the ordinate was the 10,000-foot wind direction and the abscissa was the 20,000-foot wind direction at Medford. As shown by this graph, the probability of rain is greatest with the wind at 10,000 feet from an easterly direction; and at 20,000 feet, from a direction between east and northeast. Interpretation of these facts indicates that for rain to occur in the forecast area,

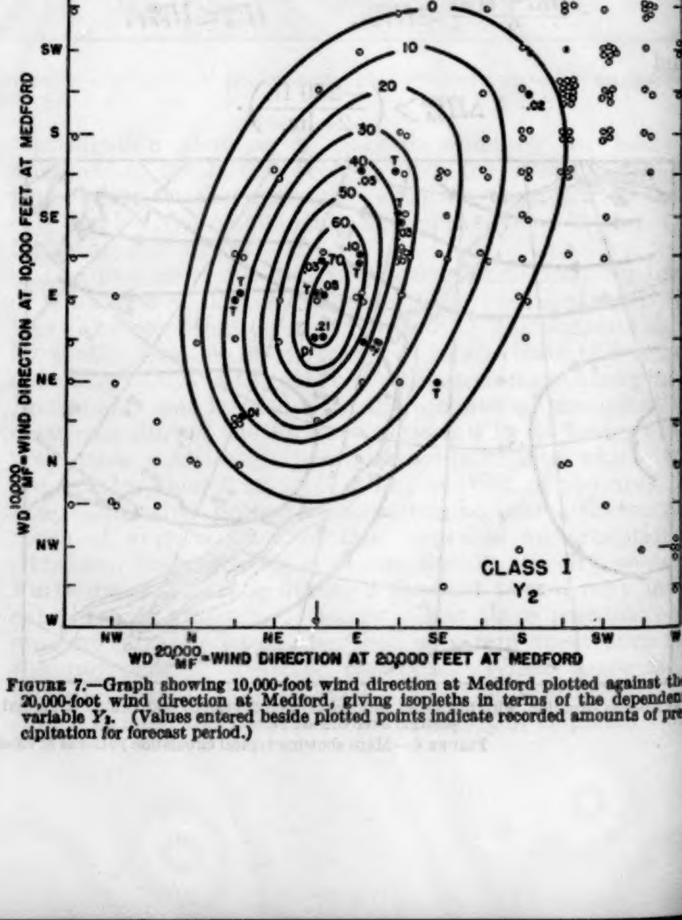


FIGURE 7.—Graph showing 10,000-foot wind direction at Medford plotted against the 20,000-foot wind direction at Medford, giving isopleths in terms of the dependent variable Y_2. (Values entered beside plotted points indicate recorded amounts of precipitation for forecast period.)

a rather deep layer of cyclonic flow is necessary, with the low pressure center to the south of Medford. In order for rain to be most probable, a slight amount of cold air advection is necessary as indicated by the backing with height. No rain occurred with the 20,000-foot wind from a south-southwest direction through north. The dependent variable taken from this graph was labeled Y_2.

The average raob code figure for relative humidity at the 700-millibar and 500-millibar levels at Santa Maria, which is an indication of the moisture available for the production of rain, was then combined with the dependent variable Y_1, giving the graph of figure 8. This combination gave the dependent variable Y_3, which is a function of the temperature at 700 millibars and the humidity at 700 millibars and 500 millibars. Thus Y_3 represents the temperature and moisture condition of the air mass over the area.

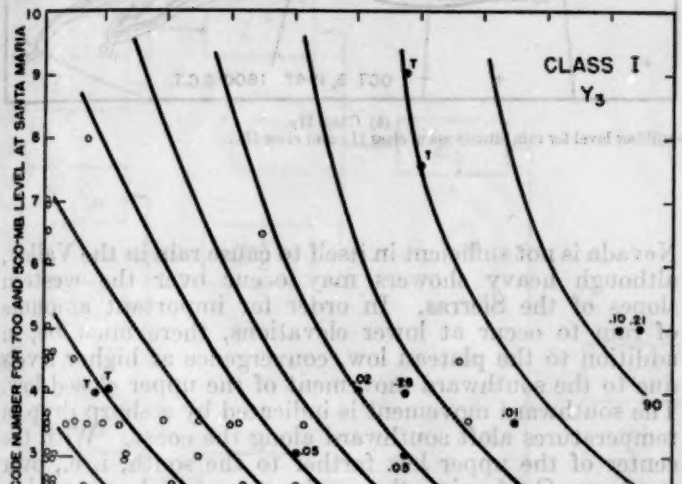


FIGURE 8.—Graph showing values of dependent variable Y_1 plotted against average raob code figure for relative humidity at the 700-millibar and 500-millibar levels at Santa Maria, giving isopleths in terms of the dependent variable Y_3.

In order to localize the center of the cyclonic circulation, indicated as essential in figure 7, the independent variables Y_2 from figure 7 was combined with the wind direction at 10,000 feet at Bakersfield. Results are shown in figure 9. The optimum wind direction at 10,000 feet over Bakersfield for the occurrence of rain is from a northeast to southeast direction, indicating that the closed center must be to the south or southwest of Bakersfield, with the central portion of the San Joaquin Valley in the north or northeast quadrant of the closed low at 10,000 feet. With a shift in the 10,000-foot wind at Bakersfield to a direction with any westerly component, the probability of rain drops off rapidly. The dependent variable Y_4 was taken from the graph of figure 9.

Combination of the variables as outlined in figure 5 was completed when the dependent variables Y_3 and Y_4 were plotted against each other to give the final rainfall parameter W, as shown in figure 10. On this graph, as in the final graphs in the Class II procedure, precipitation amounts occurring during the forecast period were entered above the plotted data and, in order to show the intensity of the storm involved, storm totals were entered in

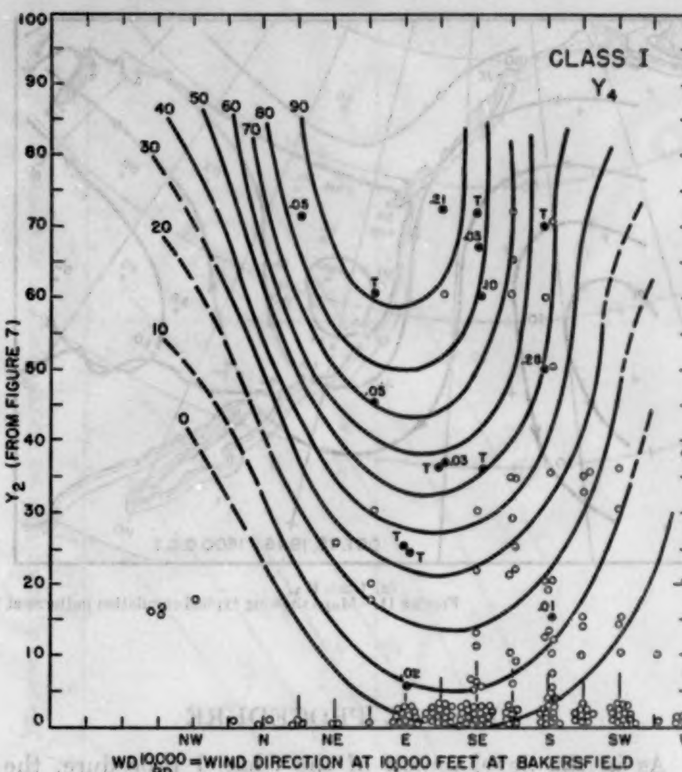


FIGURE 9.—Graph showing values of dependent variable Y_2 plotted against values for wind direction at 10,000 feet at Bakersfield, giving isopleths in terms of the dependent variable Y_4.

brackets beneath the plotted points. In several instances for which the value of W indicated that rain should have fallen, heavy precipitation actually occurred within 12 to 24 hours after the end of the forecast period. This final chart indicates that moderate to high values of both Y_3 and Y_4 are necessary for important amounts of rain to occur.

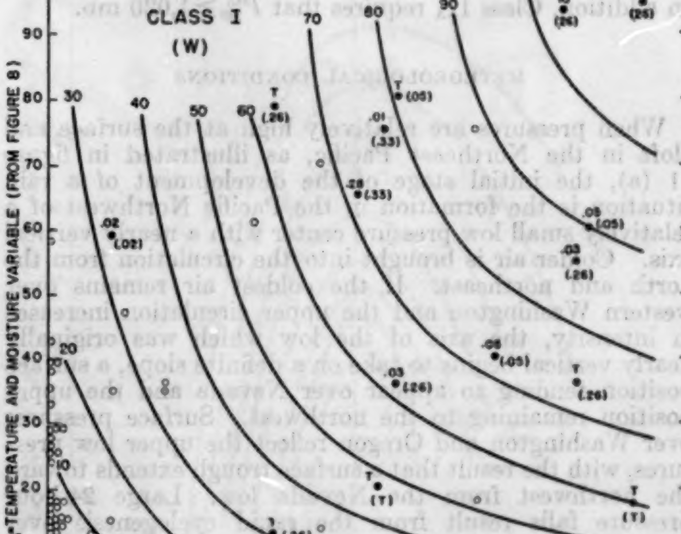
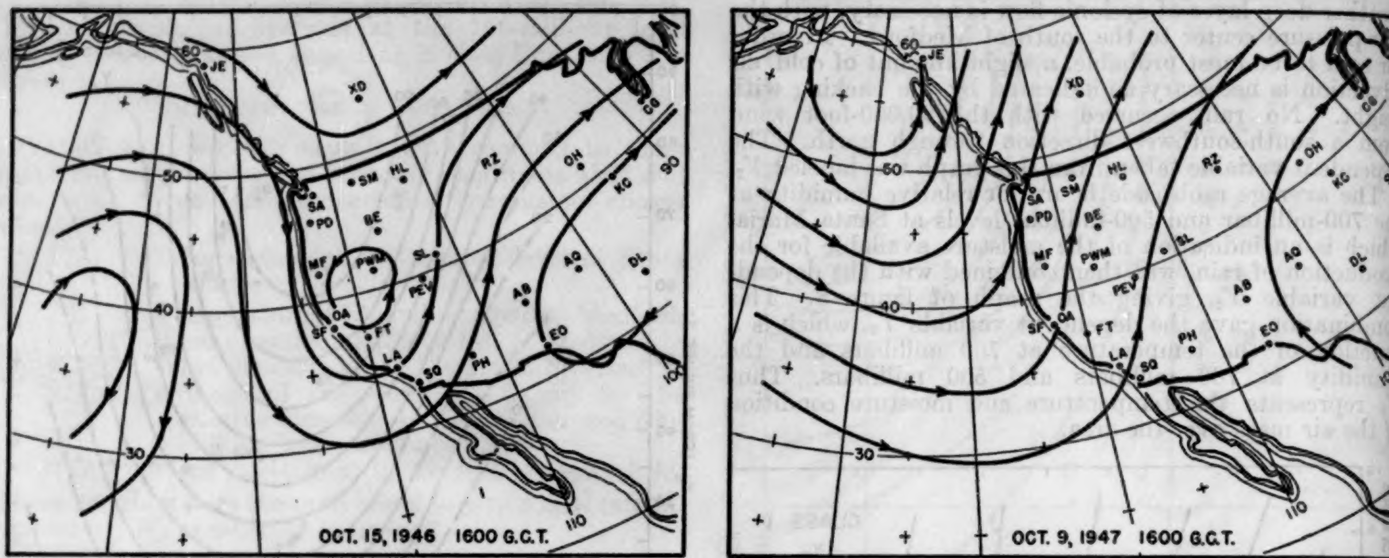


FIGURE 10.—Graph showing dependent variables Y_3 and Y_4 plotted against each other to give the final rainfall parameter W. (Values in brackets are recorded storm totals.)



(a) Class II_A. (b) Class II_B.

FIGURE 11.—Maps showing typical circulation patterns at 700-millibar level for rain situations of class II_A and class II_B.

CLASS II_A PROCEDURE

As in the development of the Class I procedure, the choice and combination of variables for Class II_A involved a consideration of the meteorological conditions associated with this type of upper-air flow. The classification procedure outlined in figure 3 (b) gave the following objective criteria for defining class II upper-air flow:

$$\frac{H^{700}_{OA}+H^{700}_{MF}}{2}\leq H^{700}_{PEV};\quad H^{700}_{SQ}>H^{700}_{PEV}$$

or

$$\Delta H^{700}_{SA}\leq\left(\frac{-250\text{ ft.}}{24\text{ hr.}}\right).$$

In addition, Class II_A requires that $P^{45}_{140}\geq 1{,}020$ mb.

METEOROLOGICAL CONDITIONS

When pressures are relatively high at the surface and aloft in the Northeast Pacific, as illustrated in figure 11 (a), the initial stage of the development of a rain situation is the formation in the Pacific Northwest of a relatively small low pressure center with a nearly vertical axis. Colder air is brought into the circulation from the north and northeast. If the coldest air remains over western Washington and the upper circulation increases in intensity, the axis of the low which was originally nearly vertical begins to take on a definite slope, a surface position tending to appear over Nevada and the upper position remaining to the northwest. Surface pressures over Washington and Oregon reflect the upper low pressures, with the result that a surface trough extends toward the northwest from the Nevada low. Large 24-hour pressure falls result from the rapid cyclogenesis over Nevada. However, the formation of an intense low over Nevada is not sufficient in itself to cause rain in the Valley, although heavy showers may occur over the western slopes of the Sierras. In order for important amounts of rain to occur at lower elevations, there must be, in addition to the plateau low, convergence at higher levels due to the southward movement of the upper closed low. The southward movement is indicated by a sharp drop in temperatures aloft southward along the coast. With the center of the upper low farther to the south, i. e., over northern California, the surface trough becomes less extensive and rainfall becomes more probable. After the cold air has reached into the area, as indicated by a relatively large 24-hour, 700-millibar temperature fall at Santa Maria, rainfall becomes much less probable due to the lack of moisture in the cold air.

METEOROLOGICAL VARIABLES

In order to measure objectively the development of a threatening rain situation of class II_A, independent variables were chosen as follows:

T^{700}_{MF}	Temperature at 700-millibar level at Medford.
ΔT^{700}_{MF}	Change in 700-millibar temperature at Medford during past 24 hours.
T^{700}_{TZM}	Temperature at 700-millibar level at Santa Maria.
ΔT^{700}_{TZM}	Change in 700 millibar temperature at Santa Maria during past 24 hours.
$H^{700}_{PEV}-H^{700}_{MF}$	Difference in 700-millibar height at Ely and Medford.
H^{700}_{MF}	Height of 700-millibar level at Medford.
$P_{SA}-P_{TEJ}$	Difference in surface pressure between Seattle and Winnemucca.
ΔP^{24}_{TEJ}	Change in surface pressure at Winnemucca during past 24 hours.

These variables were then combined to give a final rainfall parameter W^A, as outlined in figure 12. The temperature at the 700-millibar level at Medford was first plotted against its 24-hour change (fig. 13). As shown by this chart, the probability of rainfall is higher with a low temperature at Medford and with a large 24-hour fall in temperature. In this subclass where the occurrence of rain is a result of cyclogenesis over the plateau, the low temperature aloft at Medford indicates the availability of sufficiently cold air to initiate the cyclogenesis, while the 24-hour fall in the temperature shows the necessary southward movement of the cold air mass. The dependent variable Z_1^A was obtained from this chart.

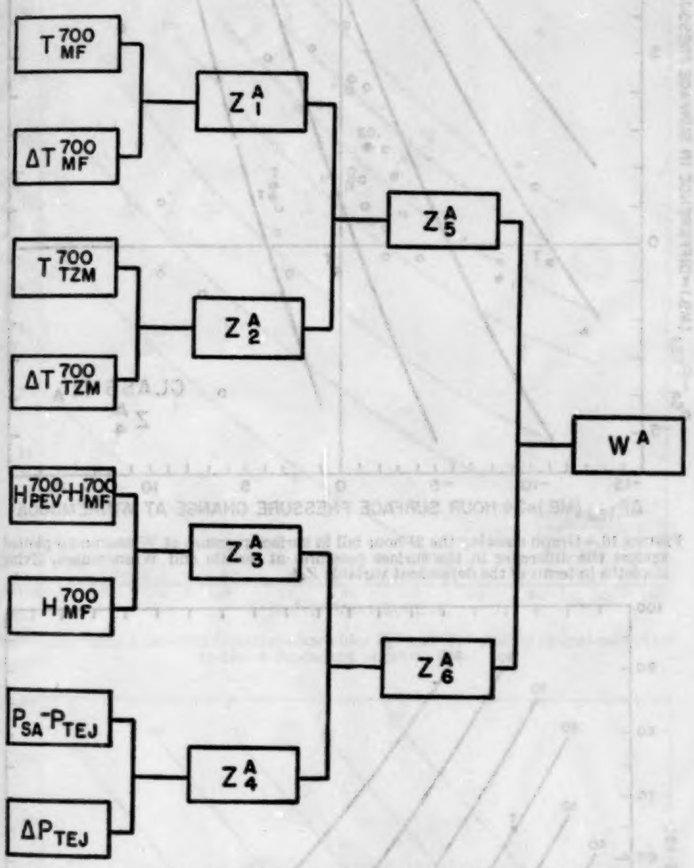


FIGURE 12.—Schematic diagram showing method for combining variables chosen for class II_A situations into final rainfall parameter, W^A.

The same variables were plotted for Santa Maria (fig. 14), giving the dependent variable Z_2^A. Marked differences can be noted in the distribution of the rainfall occurrence in the two charts, figures 13 and 14. Rainfall is most likely with a 700-millibar temperature at Santa Maria of 0° C. There are indications that a small 24-hour fall in the temperature, ranging from 0° C. to 2° C., gives rise to the highest probability of rain during the following 6- to 24-hour period, while a 24-hour fall in excess of 2° C. indicates a rapid decrease in the likelihood of rain. This relationship may be interpreted as indicating that by the time the cold air has reached as far southward as central California, the influx of air with a lower moisture content—together with a gradual eastward movement of the low pressure system—no longer places the lower elevations of central California in the rain area of the storm.

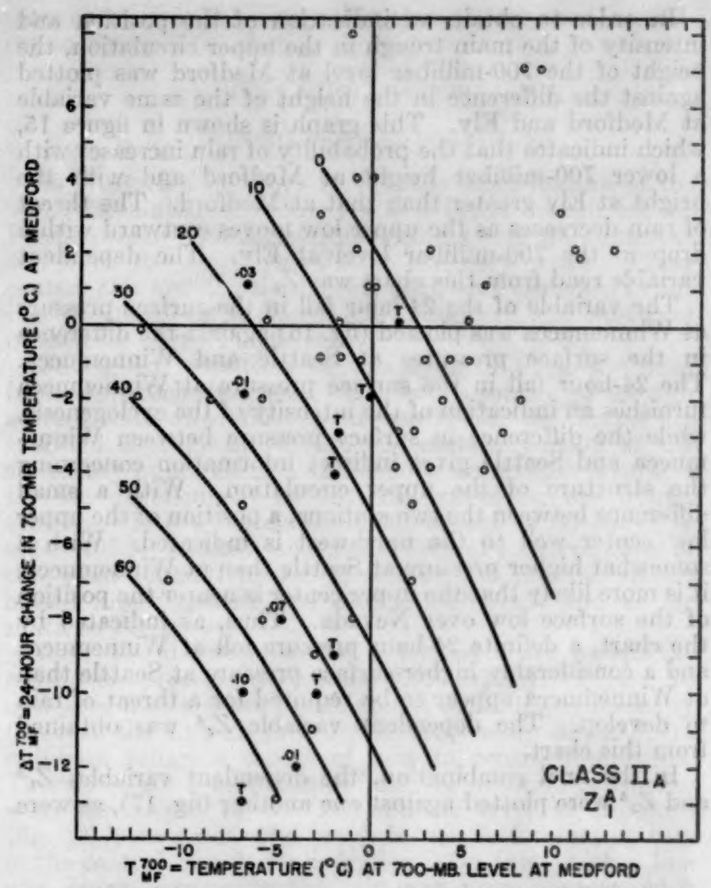


FIGURE 13.—Graph showing temperature at 700-millibar level at Medford plotted against its 24-hour change, giving isopleths in terms of the dependent variable Z_1^A.

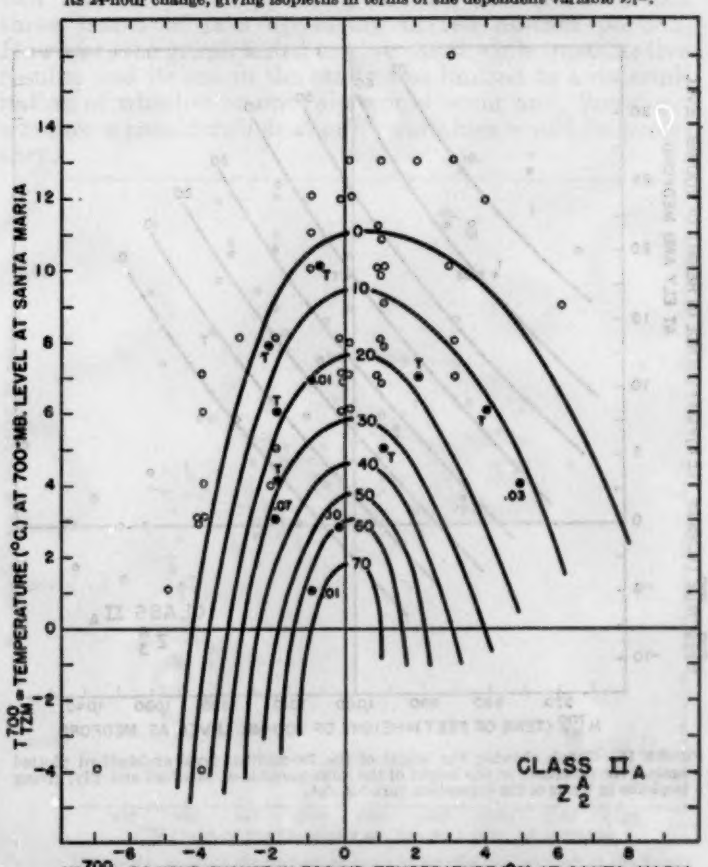


FIGURE 14.—Graph showing temperature at 700-millibar level at Santa Maria plotted against its 24-hour change, giving isopleths in terms of the dependent variable Z_2^A.

In order to obtain an indication of the position and intensity of the main trough in the upper circulation, the height of the 700-millibar level at Medford was plotted against the difference in the height of the same variable at Medford and Ely. This graph is shown in figure 15, which indicates that the probability of rain increases with a lower 700-millibar height at Medford and with the height at Ely greater than that at Medford. The threat of rain decreases as the upper low moves eastward with a drop in the 700-millibar level at Ely. The dependent variable read from this chart was Z_3^A.

The variable of the 24-hour fall in the surface pressure at Winnemucca was plotted (fig. 16) against the difference in the surface pressures at Seattle and Winnemucca. The 24-hour fall in the surface pressure at Winnemucca furnishes an indication of the intensity of the cyclogenesis, while the difference in surface pressure between Winnemucca and Seattle gives indirect information concerning the structure of the upper circulation. With a small difference between the two stations, a position of the upper low center well to the northwest is indicated. With a somewhat higher pressure at Seattle than at Winnemucca, it is more likely that the upper center is nearer the position of the surface low over Nevada. Thus, as indicated by the chart, a definite 24-hour pressure fall at Winnemucca and a considerably higher surface pressure at Seattle than at Winnemucca appear to be required for a threat of rain to develop. The dependent variable Z_4^A was obtained from this chart.

In the final combination, the dependent variables Z_1^A and Z_2^A were plotted against one another (fig. 17), as were

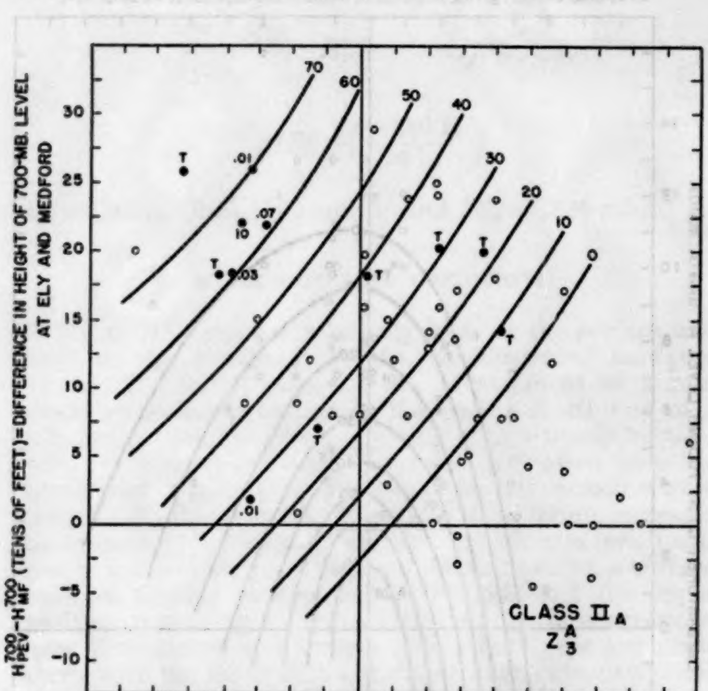


FIGURE 15.—Graph showing the height of the 700-millibar level at Medford plotted against the difference in the height of the same variable at Medford and Ely, giving isopleths in terms of the dependent variable Z_3^A.

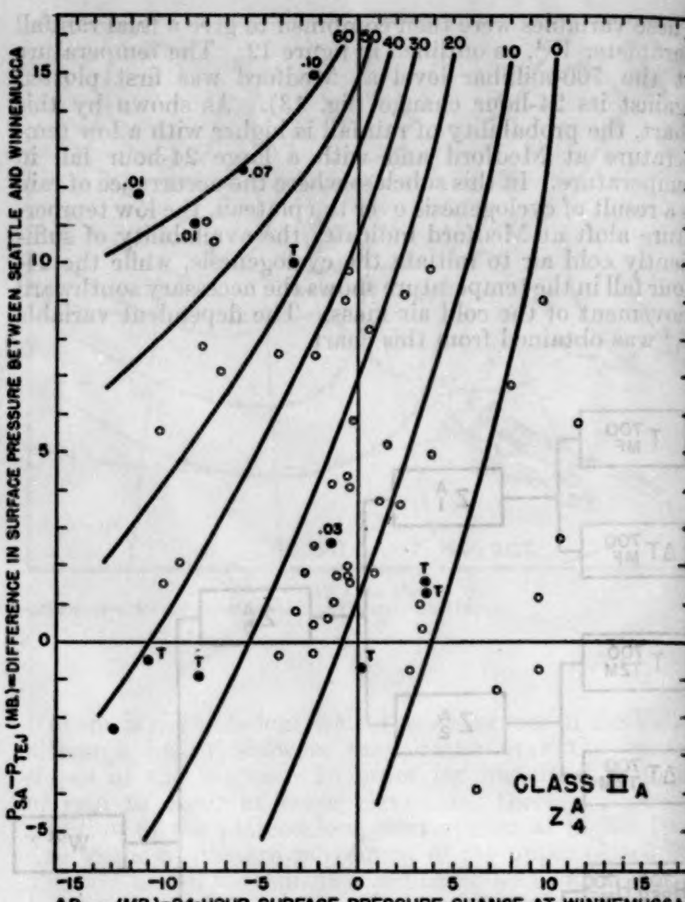


FIGURE 16.—Graph showing the 24-hour fall in surface pressure at Winnemucca plotted against the difference in the surface pressures at Seattle and Winnemucca, giving isopleths in terms of the dependent variable Z_4^A.

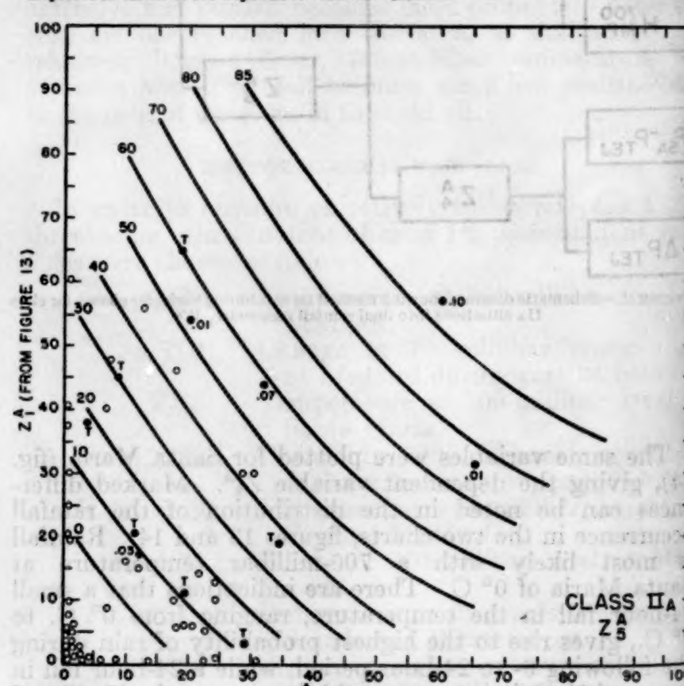


FIGURE 17.—Graph showing dependent variables Z_1^A and Z_2^A plotted against each other to derive dependent variable Z_5^A.

variables Z_3^A and Z_4^A (fig. 18). Results from each of these graphs were dependent variables Z_5^A and Z_6^A, respectively, and they were in turn combined (fig. 19) to give a final rainfall parameter $W.^A$

CLASS II_B PROCEDURE

The development of class II_B procedure involved the same type of consideration found useful in classes I and II_A. Again, a study of meteorological conditions associated with the upper-air flow was made. The objective criteria defining class II_B upper-air flow were the same as for class II_A, except that class II_B required, according to figure 3 (b) that

$$P^{45}_{140}<1{,}020 \text{ millibars}$$

METEOROLOGICAL CONDITIONS

As illustrated in figure 11 (b), the main feature of the upper circulation for class II_B is a broad trough off the Pacific coast. The anticyclonic centers over the continent and over the Northeast Pacific are very weak. These centers also are displaced southward and eastward in the case of the continental cell, and southward and westward in the case of the Pacific cell.

During the existence of this type of upper-air flow, fronts approach the Pacific coast from a southwest through a northwest direction. Near the coast, the fronts are retarded as they move into the eastern portion of the stationary upper trough, and conditions become favorable for the development of unstable waves on the frontal systems. If a wave development occurs as far south as about 40° N. latitude, and within several hundred miles of the coast, conditions are favorable for rain to spread inland into northern and central California and as far south as Fresno.

With the development of a frontal wave just off the coast, the pressure at Eureka falls rapidly. Figure 20 indicates that a wave development of sufficient intensity to cause the Eureka pressure to drop below about 1,015 millibars brings a threat of rain to central California. Therefore, the combination of surface pressure at Eureka with the height of the 700-millibar level at Medford (fig. 20) gave a powerful graph for use in forecasting rain in the central San Joaquin Valley. On this graph a line was drawn separating the rain and no-rain cases, with two no-rain cases appearing in the rain portion, and three traces of rain appearing in the no-rain portion. However, the graph failed to give worthwhile quantitative results, and its use in the study was limited to a determination of whether or not rain would occur and, therefore, whether a consideration of other variables would be necessary.

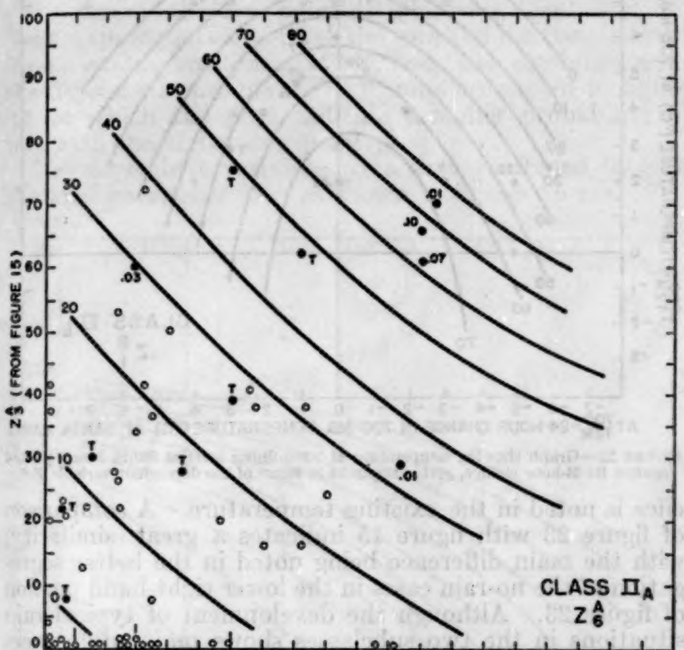


FIGURE 18.—Graph showing dependent variables Z_3^A and Z_4^A plotted against each other to derive dependent variables Z_6^A.

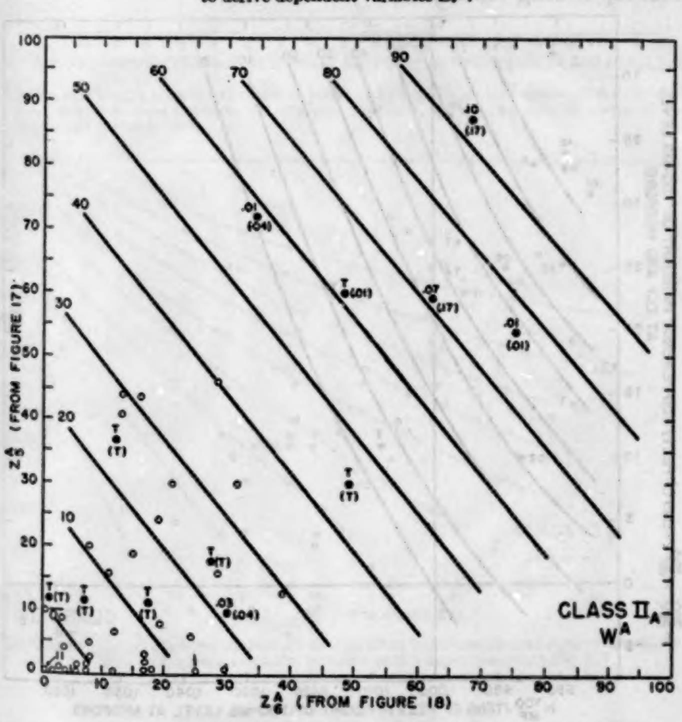


FIGURE 19.—Graph showing dependent variables Z_5^A and Z_6^A plotted against each other to give the final rainfall parameter W^A.

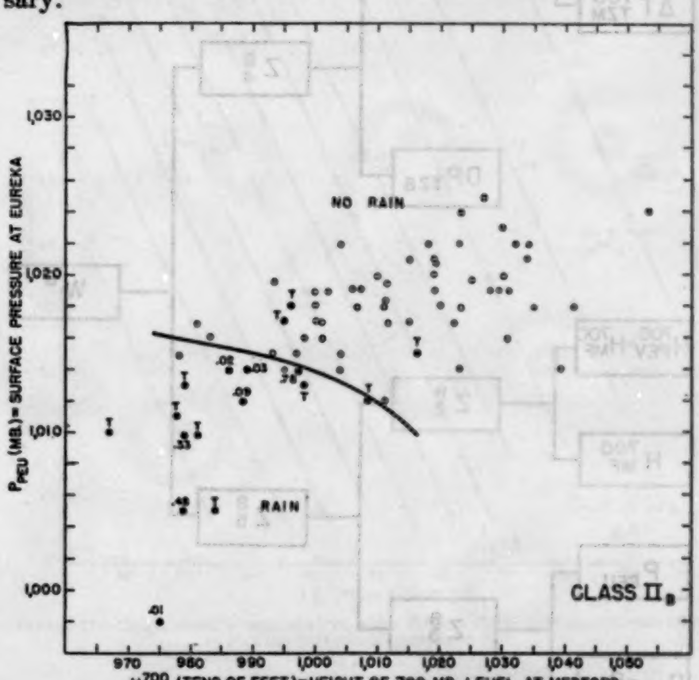


FIGURE 20.—Graph showing the surface pressure at Eureka plotted against the height of the 700-millibar level at Medford, for forecasting rain occurrence in class II_B situations.

The wave developments during class II_B conditions appear to have the ability to "carry" sufficient moisture along with the disturbance to cause heavy rain over a wide area, even though the air mass a short distance in front of the system is relatively dry. However, if moist tropical air has been bought into the circulation prior to the wave development and remains in the area, the convergence associated with the deepening wave may cause heavy showers several hundred miles ahead of the front.

METEOROLOGICAL VARIABLES

From the above considerations the following independent variables were chosen:

- T^{700}_{TZM} Temperature at 700-millibar level at Santa Maria.
- ΔT^{700}_{TZM} Change in 700 millibar temperature at Santa Maria during past 24 hours.
- DP_{TZB} Surface dew point at Sandberg.
- H^{700}_{MF} Height of 700-millibar level at Medford.
- $H^{700}_{PEV}-H^{700}_{MF}$ Difference in height at 700-millibar level between Ely and Medford.
- P_{PEU} Surface pressure at Eureka.
- $P_{PEU}-P_{PD}$ Difference in surface pressure between Eureka and Portland.

These seven variables were then combined to give a final rainfall parameter, W^B, as outlined in figure 21. First, figures 22 and 23 were plotted, using the same variables as those used in figures 14 and 15, respectively, in the treatment of class II_A situations. In figure 22, as compared with figure 14, a somewhat greater 24-hour fall in the temperature at the 700-millibar level at Santa Maria is associated with a rain situation, but only a slight difference is noted in the existing temperature. A comparison of figure 23 with figure 15 indicates a great similarity, with the main difference being noted in the better segregation of the no-rain cases in the lower right-hand portion of figure 23. Although the development of typical rain situations in the two subclasses shows major differences as to origin and growth, the upper-air characteristics are similar to the extent indicated by a comparison of the corresponding charts.

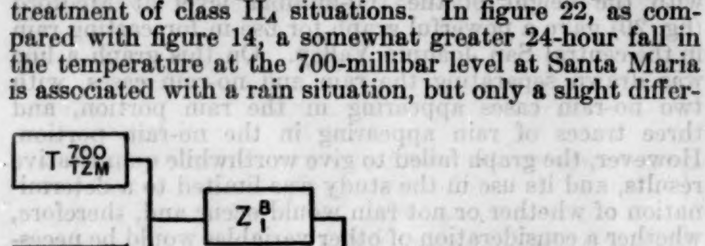


FIGURE 21.—Schematic diagram showing method for combining variables chosen for class II_B situations into final rainfall parameter W^B.

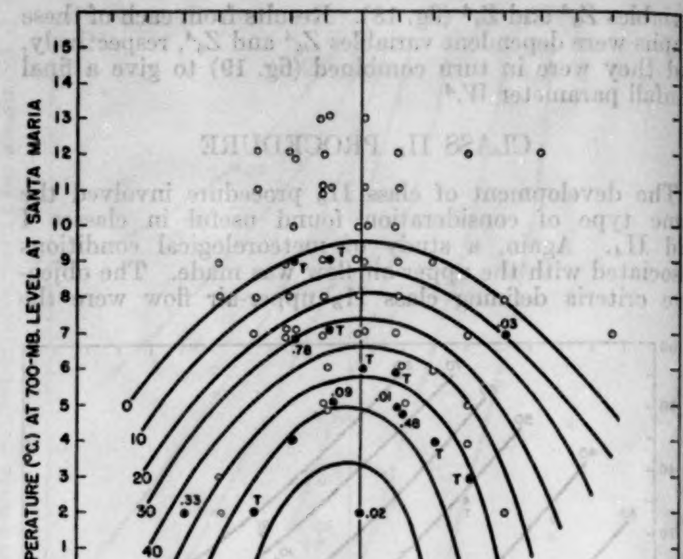


FIGURE 22.—Graph showing temperature at 700-millibar level at Santa Maria plotted against its 24-hour change, giving isopleths in terms of the dependent variable Z_1^B.

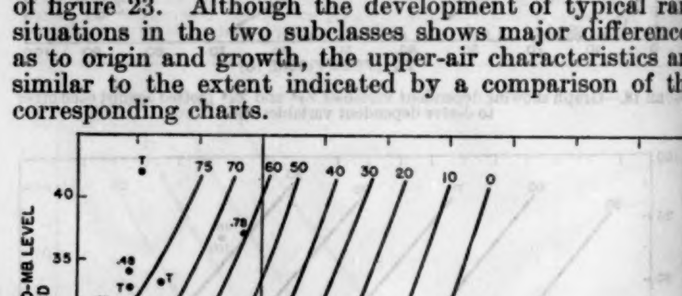


FIGURE 23.—Graph showing the height of the 700-millibar level at Medford plotted against the difference in the height of the same variable at Medford and Ely, giving isopleths in terms of the dependent variable Z_2^B.

Much better stratification of rainfall data than that already found in figure 20 was obtained by pairing the surface pressure at Eureka with a second variable indicating the location of the lowest pressure along the coast relative to Eureka and Portland. The pressure at Eureka was combined with the difference in pressure between Eureka and Portland, as shown in figure 24. As indicated by this chart, the probability of important amounts of rain becomes greater with a low pressure at Eureka and with a value near or lower than at Portland.

As a means of detecting the type of situation in which abnormally moist air invades the area prior to the wave development, the dew point at Sandberg, located in the Tehachapi mountains just to the south of the San Joaquin Valley at an elevation of 4,517 feet, was combined with the dependent variable Z_1^B. Results are shown in figure 25, in which the data indicate a higher probability of rain with the higher dew points.

The dependent variables were then combined to give the final parameter W^B, as shown in figures 26 and 27.

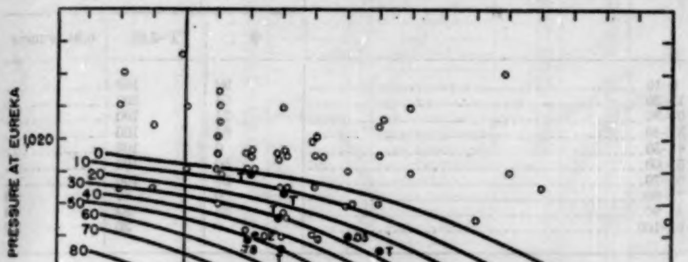


FIGURE 24.—Graph showing the surface pressure at Eureka plotted against the difference in surface pressures between Eureka and Portland, giving isopleths in terms of the dependent variable Z_3^B.

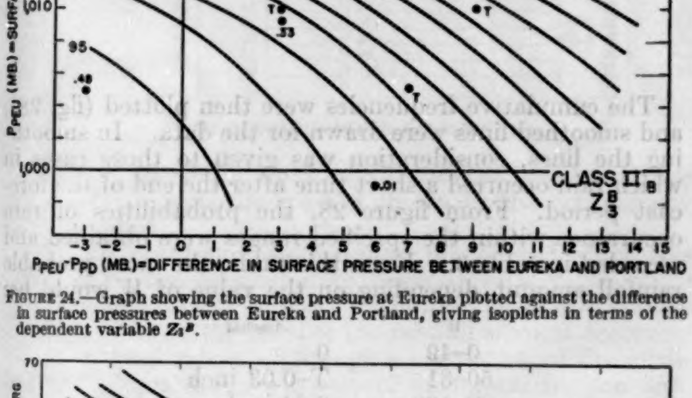


FIGURE 25.—Graph showing the surface dew point at Sandberg plotted against dependent variable Z_1^B, giving isopleths in terms of the dependent variable Z_4^B.

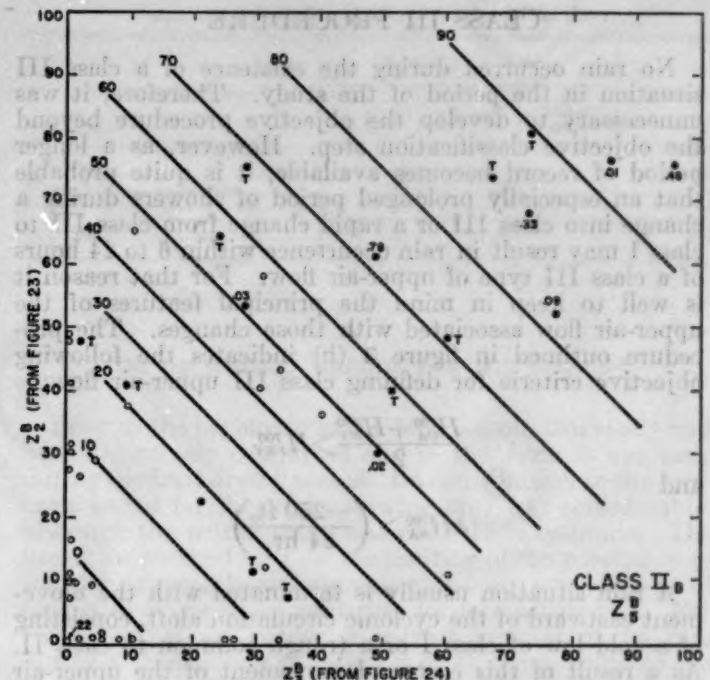


FIGURE 26.—Graph showing dependent variables Z_2^B and Z_3^B plotted against each other to derive the dependent variable Z_5^B.

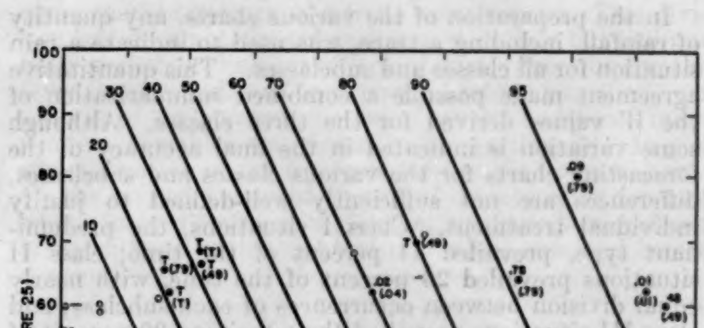


FIGURE 27.—Graph showing dependent variables Z_4^B and Z_5^B plotted against each other to give the final rainfall parameter W^B.

CLASS III PROCEDURE

No rain occurred during the existence of a class III situation in the period of the study. Therefore, it was unnecessary to develop the objective procedure beyond the objective classification step. However, as a longer period of record becomes available, it is quite probable that an especially prolonged period of showers during a change into class III or a rapid change from class III to class I may result in rain occurrence within 6 to 24 hours of a class III type of upper-air flow. For that reason it is well to keep in mind the principal features of the upper-air flow associated with those changes. The procedure outlined in figure 3 (b) indicates the following objective criteria for defining class III upper-air flow:

$$\frac{H^{700}_{OA}+H^{700}_{MF}}{2}>H^{700}_{PRV}$$

and

$$\Delta H^{700}_{SA}>\left(\frac{-250\text{ ft.}}{24\text{ hr.}}\right)$$

A rain situation usually is terminated with the movement eastward of the cyclonic circulation aloft, consisting of a cold low of class I or a trough common to class II. As a result of this eastward movement of the upper-air systems, the winds aloft along the Pacific Coast shift into a northerly direction, with the pressure distribution aloft satisfying the criteria set up for class III. Although this class is quite often a transitional stage between class I and class II, with a relatively short duration, it may persist for a considerable period if the high pressure ridge aloft is of sufficient intensity.

APPLICATION OF THE CHARTS

In the preparation of the various charts, any quantity of rainfall, including a trace, was used to indicate a rain situation for all classes and subclasses. This quantitative agreement made possible a combined summarization of the W values derived for the three classes. Although some variation is indicated in the final accuracy of the forecasting charts for the various classes and subclasses, differences are not sufficiently well-defined to justify individual treatment. Class I situations, the predominant type, prevailed 44 percent of the time; class II situations prevailed 26 percent of the time, with nearly equal division between occurrences of each subclass; and class III situations prevailed the remaining 30 percent of the period of study.

RELATION OF W TO PRECIPITATION AMOUNTS

Although W was defined for the purpose of estimating the probability of rain, it was studied further as an indicator of rainfall amounts. In order to obtain a relationship between W and the occurrence of various rain amounts during a period 6 to 24 hours after forecast time, the number of occurrences of various values of W within specified ranges of precipitation was tabulated by employing the graphs in figures 10, 19, and 27. The results of the tabulation are shown in table 1. In designating these ranges, amounts of 0.04 inch or more were combined into one range of precipitation, inasmuch as it was considered probable that when the 6 rainfall stations averaged as much as 0.04 inch of rain, some areas would record damaging amounts of precipitation. From table 1, cumulative percentage frequencies of the various W values within specified limits of precipitation amounts were derived (shown in table 2).

TABLE 1.—*Tabulation of the number of occurrences of various W values within specified ranges of precipitation*

W	Precipitation amounts (inches)		
	0	T-0.03	0.04 or more
0-10	390	3	0
11-20	30	2	0
21-30	14	5	0
31-40	7	4	0
41-50	0	1	0
51-60	3	3	0
61-70	3	5	0
71-80	0	6	3
81-90	2	3	1
91-100	0	3	7

TABLE 2.—*Cumulative percentage frequencies of the various W values within specified ranges of precipitation (computed from table 1)*

W	Precipitation amounts (inches)		
	0	T-0.03	0.04 or more
0-10	99	100	----------
11-20	94	100	----------
21-30	74	100	----------
31-40	64	100	----------
41-50	0	100	----------
51-60	50	100	----------
61-70	38	100	----------
71-80	0	67	100
81-90	33	83	100
91-100	0	30	100

The cumulative frequencies were then plotted (fig. 28), and smoothed lines were drawn for the data. In smoothing the lines, consideration was given to those cases in which rain occurred a short time after the end of the forecast period. From figure 28, the probabilities of rain occurrence within the specified ranges were obtained and recorded in table 3. From this table, the most probable rainfall amount, depending on the value of W would be:

W	*Amount*
0–49	0
50–81	T–0.03 inch
82–100	0.04 inch or more

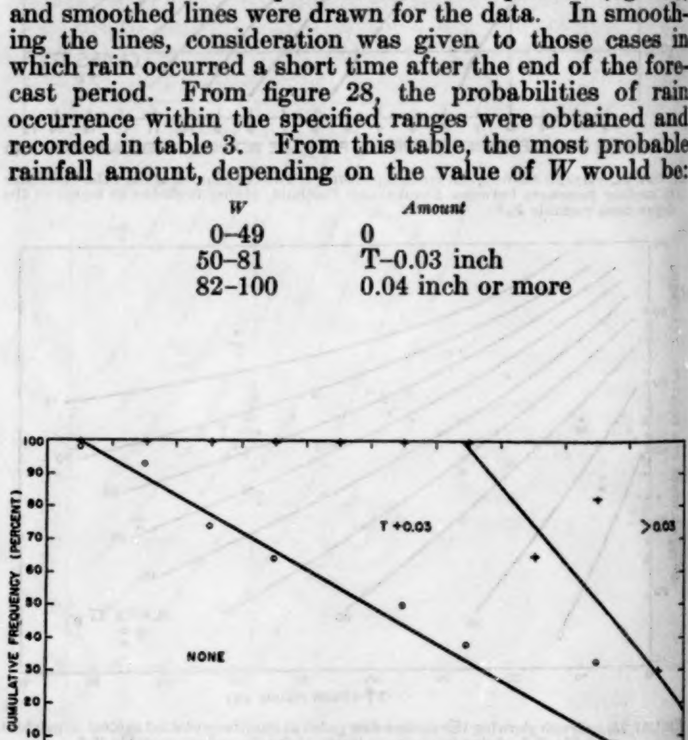


FIGURE 28.—Graph showing relationship between values of rainfall parameter W and the cumulative frequencies of occurrence of various rain amounts during a period 6 to 24 hours after forecast time. (See table 2.)

TABLE 3.—*Relation between W and the probability that the rain amount will fall within a specified range*

W	0	T–0.03	0.04 or more	W	0	T–0.03	0.04 or more
1	100			51	49	51	
2	100			52	47	53	
3	100			53	46	54	
4	100			54	45	55	
5	100			55	44	56	
6	99	1		56	43	57	
7	97	3		57	42	58	
8	96	4		58	41	59	
9	95	5		59	40	60	
10	94	6		60	39	61	
11	93	7		61	37	63	
12	92	8		62	36	64	
13	91	9		63	35	65	
14	90	10		64	34	66	
15	89	11		65	33	65	2
16	88	12		66	32	64	4
17	86	14		67	31	62	7
18	85	15		68	30	61	9
19	84	16		69	29	60	11
20	83	17		70	28	58	14
21	82	18		71	26	58	16
22	81	19		72	25	57	18
23	80	20		73	24	56	20
24	79	21		74	23	54	23
25	78	22		75	22	53	25
26	77	23		76	21	52	27
27	75	25		77	20	50	30
28	74	26		78	18	50	32
29	73	27		79	17	49	34
30	72	28		80	16	47	37
31	71	29		81	15	46	39
32	70	30		82	14	43	43
33	68	32		83	13	43	44
34	67	33		84	12	42	46
35	66	34		85	11	41	48
36	65	35		86	10	40	50
37	64	36		87	8	39	53
38	63	37		88	7	38	55
39	62	38		89	6	37	57
40	61	39		90	5	35	60
41	60	40		91	4	34	62
42	59	41		92	3	33	64
43	57	43		93	2	31	67
44	56	44		94	1	30	69
45	55	45		95	0	29	71
46	54	46		96		27	73
47	53	47		97		24	76
48	52	48		98		22	78
49	51	49		99		20	80
50	50	50		100		17	83

FORECASTING SKILL OF METHOD

Applied to the original data, forecasts based on these ranges in W gave the results shown in the contingency table, table 4.

The standard skill score testing procedure[2] which was applied to the original data resulted in a value of 70 percent on a rain (T or more) or no-rain basis, and a value of 61 percent on the basis of the rainfall amount occurring in the correct range. Through a separation of the qualitative and quantitative aspects of the forecasting problem, considerable improvement probably could be effected in the quantitative value of the forecasting method.

TABLE 4.—*Forecast verification of original data*

OBSERVED (inches)	FORECAST (inches)			Total
	0	T to 0.03	0.04 or more	
0	441	6	2	449
T to 0.03	15	15	5	35
0.04 or more	0	3	8	11
Total	456	24	15	495

USE OF METHOD DURING THE 1947 SEASON[3]

Prior to the beginning of the 1947 season, this study had been tentatively completed and in this form it was used during the fruit drying season. Its contribution to the forecasts issued for the raisin-growing area was considerable, although the actual value was difficult to estimate. The use of the method to show the limiting of the possibility of rain for apparently threatening situations proved to be of almost as much value as its use for forecasting rain. For reasons explained earlier, a correct forecast of no rain during a threatening situation is of as much value to the fruit growers as a correct rain forecast.

At the end of the 1947 season, the possible addition of another year's record to the short period available, together with the insight gained from another season's use, indicated the advisability of the inclusion of the 1947 data in the final results. A slight change was made in the objective criteria differentiating between class I and class II, but no revision was made in class III.

However, it was found that in class II, a division of the class into two subtypes to distinguish between a westerly or northerly approach of a front was essential. This division had been anticipated earlier in the study but had not been carried out because of lack of data. Accordingly, the revision was made and incorporated into the method. As a result of the revision, the use of several additional independent variables was found to be worthwhile. In the summarization of the forecasts for the 1947 season (table 5), the revised values of W and of the objective forecast when changed by the completed study have been entered in parentheses to the right of the values obtained before revision.

CONCLUSIONS

1. The development of an objective forecasting method such as described in this report appears to rest on (*a*) a division of map types into meteorologically sound classifications, and (*b*) a choice of independent variables suitable to each classification.

2. Whether the objective method developed is used in whole or in part, the relationships shown between the different variables are of considerable value to the forecaster in the forecasting occurrence of rain or in the limiting of the amount of rain to be expected.

3. Independent data are not available for satisfactory tests of the method other than that already indicated for the 1947 season. Until such tests become possible, the use of the method must be restricted to support of general forecasting procedures.

4. With the accumulation of more cases, further refinements will become worth while. The number of cases in

[2] The skill score, S_e, in this study is defined by

$$S_e=\frac{C-E_e}{T-E_e}$$

where C=number of correct forecasts, E_e=number of forecasts expected to be correct due to chance, and T=total number of forecasts.

It has a value of unity when all forecasts are correct, and zero when the number of correct forecasts is equal to the number expected to be correct due to chance. The value of E_e for forecasts of "rain" or "no rain" is given by

$$E_e=R\times f_r+N(1-f_r)$$

where R=forecast number of rain cases during the period covered by forecasts; N=forecast number of no-rain cases during period covered by forecasts and f_r=relative frequency of occurrence of rain cases during the period covered by forecasts. (From Table 4: $C=472$; $T=495$; $R=39$; $f_r=\frac{46}{495}$; $N=456$; $(1-f_r)=\frac{449}{495}$; $S_e=.70$.)

The value of E_e on the basis of forecasts for the rainfall amounts in the specified ranges is given by

$$E_e=R_1\times f_1+R_2\times f_2+N(1-f_1-f_2)$$

where R_1=forecast number of rain cases falling in the range T to 0.03 inch during the period covered by forecasts; R_2=forecast number of rain cases falling in the range 0.04 inch or more during the period covered by forecasts; N=forecast number of no-rain cases during the period covered by forecasts; f_1=relative frequency of occurrence of rain cases in the range T to 0.03 inch during the period covered by forecasts; and f_2=relative frequency of occurrence of rain cases in the range 0.04 or more during the period covered by the forecasts. (From Table 4: $C=464$; $T=495$; $R_1=24$; $f_1=\frac{35}{495}$; $R_2=15$; $f_2=\frac{11}{495}$; $N=456$; $1-f_1-f_2=\frac{449}{495}$; $S_e=.61$.)

[3] Although complete verification data are not available for the 1948 raisin-drying season, the author has indicated that the method again gave good results. A skill score of .62 based on climatology derived from the study, was attained during the season.—*Editor.*

TABLE 5.—*Summary of objective and actual precipitation forecasts for the 1947 season and their verifications*

Date	Class	*W*	10:30 a. m. objective forecast	Actual forecast	Observed weather	Class	*W*	10:30 p. m. objective forecast	Actual forecast	Observed weather
September 1947										
1	I	0	NR	NR	NR	I	5	NR	NR	NR
2	I	0	NR	NR	NR	II_A	0 (0)	NR	NR	NR
3	I	0	NR	NR	NR	II_A	0 (0)	NR	NR	NR
4	I	0	NR	NR	NR	I	0	NR	NR	NR
5	I	0	NR	NR	NR	II_B	0 (0)	NR	NR	NR
6	II_B	8 (0)	NR	NR	NR	II_B	42 (0)	NR	Few spkls or very lgt shwrs	NR
7	II_B	31 (0)	NR	NR	NR	II_B	23 (0)	NR	NR	NR
8	II_B	10 (0)	NR	NR	NR	III	0	NR	NR	NR
9	II_A	31 (2)	NR	NR	NR	III	0	NR	NR	NR
10	III	0	NR	NR	NR	III	0	NR	NR	NR
11	I	0	NR	NR	NR	I	0	NR	NR	NR
12	III	0	NR	NR	NR	III	0	NR	NR	NR
13	III	0	NR	NR	NR	III	0	NR	NR	NR
14	I	0	NR	NR	NR	I	0	NR	NR	NR
15	I	0	NR	NR	NR	I	0	NR	NR	NR
16	II_A	13 (6)	NR	Few spkls	NR	II_A	95 (77)	>.03(T-.03)	Ocnl lgt shwrs.	.01
17	II_A	95 (61)	>.03(T-.03)	NR	T	II_A	33 (0)	NR	NR	NR
18	II_A	12 (6)	NR	NR	NR	II_A	3 (0)	NR	NR	NR
19	I	0	NR	NR	NR	I	10	NR	NR	NR
20	I	25	NR	NR (Few lgt shwrs next day)*	NR	I	59	T-.03	NR	T
21	I	23	NR	Threat of rain remaining.	T	I	56	T-.03	Few lgt shwrs	NR
22	I	32	NR	NR	NR	I	0	NR	NR	NR
23	I	0	NR	NR	NR	I	0	NR	NR	NR
24	I	0	NR	NR	NR	I	0	NR	NR	NR
25	I	0	NR	NR	NR	II_B	0 (0)	NR	NR	NR
26	II_B	0 (0)	NR	NR	NR	I	0	NR	NR	NR
27	I	0	NR	NR	NR	I	0	NR	NR	NR
28	I	0	NR	NR	NR	II_B	10 (0)	NR	NR	NR
29	I	0	NR	NR	NR	I	0	NR	NR	NR
30	I	0	NR	NR	NR	II_B	10 (0)	NR	NR	NR
October 1947										
1	II_B	23 (0)	NR	NR	NR	II_B	9 (0)	NR	NR	NR
2	II_B	10 (0)	NR	NR	NR	III	0	NR	NR	NR
3	III	0	NR	NR	NR	I	0	NR	NR	NR
4	I	18	NR	NR	NR	II_A	16 (22)	NR	NR	NR
5	I	0	NR	NR	NR	II_B	61 (3)	T-.03(NR)	NR	NR
6	II_B	52 (51)	T-.03	NR	NR	II_B	43 (74)	NR(T-.03)	Few spkls north ptn	T
7	II_B	78 (94)	T-.03(>.03)	Few spkls	T	II_B	61 (70)	T-.03	Very lgt rain north ptn next day	NR
8	II_B	43 (33)	NR	NR	T	II_B	13 (50)	NR(T-.03)	Few spkls north Ft	.03
9	II_B	55 (97)	T-.03(>.03)	Rain tonight	.48	II_B	39 (93)	NR(>.03)	Few shwrs this mrng	.33
10	II_B	42 (80)	NR(T-.03)	Sctd lgt shwrs tonight	T	II_B	37 (19)	NR	Few shwrs	NR
11	III	0	NR	NR	NR	III	0	NR	NR	NR
12	III	0	NR	NR	NR	III	0	NR	Sctd lgt shwrs Ft. south	NR
13	III	0	NR	NR	NR	III	0	NR	NR	NR
14	II_B	38 (0)	NR	NR	NR	II_B	42 (5)	NR	Lgt rain north of Ft. late tonight	NR
15	II_B	75 (93)	T-.03(>.03)	Mdt to hvy rain late tonight and next day.	T	II_B	62 (96)	T-.03(>.03)	Itmt rain Ft. north by aftn and over vly tonight and next day.	.01

*On Sept. 20, the warning direct to growers stated "scattered light showers late tonight, with possibly heavier showers tomorrow." This warning resulted in the stacking or rolling of about 50 percent of the exposed raisin crop.

class II is limited by the fact that it is more of a winter situation, occurring generally later in the season. With further cases of cyclogenesis off the coast, the quantitative aspects of class II_B may be improved.

5. In developing the method, the selection and combination of the variables was determined by occurrence of rain rather than by the amounts of rain. Some improvement may be gained by incorporating the rain amounts in the selection and treatment of the independent variables.

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METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR FEBRUARY 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during February, 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,009.6 mb.)				Albuquerque, N. Mex. (836.9 mb.)				Atlanta, Ga. (986.8 mb.)				Big Spring, Tex. (928.4 mb.)				Bismarck, N. Dak. (955.8 mb.)				Boise, Idaho (914.3 mb.)				Brownsville, Tex. (1,016.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	86	−2.1	74	28	1,620	4.2	43	28	300	10.7	69	28	774	8.0	62	28	505	−16.2	77	28	868	−0.9	77	28	6	17.4	90
1,000	28	161	−2.6	70	28	141	(*)	----	28	188	(*)	----	28	152	(*)	----	28	161	(*)	----	28	146	(*)	----	28	147	17.5	87
950	28	575	−3.2	67	28	576	(*)	----	28	619	10.8	61	28	584	(*)	----	28	555	(*)	----	28	565	(*)	----	28	591	16.9	82
900	28	994	−4.5	66	28	1,025	(*)	----	28	1,067	9.6	56	28	1,033	10.5	54	28	960	−13.2	73	28	995	.7	66	28	1,048	15.9	70
850	28	1,444	−5.2	64	28	1,492	(*)	----	28	1,540	8.0	52	28	1,508	9.1	49	28	1,397	−10.7	68	28	1,452	−1.6	60	28	1,532	13.9	64
800	28	1,919	−6.4	56	28	1,986	3.1	39	28	2,039	6.3	47	28	2,008	7.0	41	28	1,864	−10.7	62	28	1,932	−4.8	61	28	2,041	12.4	54
750	28	2,428	−7.7	45	28	2,509	−.5	44	28	2,571	4.2	----	28	2,541	4.0	33	28	2,364	−12.5	61	28	2,439	−8.1	62	28	2,589	10.2	42
700	28	2,957	−9.6	40	28	3,053	−4.1	46	28	3,125	1.9	----	28	3,093	.2	36	28	2,884	−14.8	59	28	2,970	−11.4	62	28	3,151	6.7	40
650	28	3,532	−12.3	36	28	3,638	−8.1	45	28	3,720	−1.7	----	28	3,687	−4.0	35	28	3,447	−17.8	59	28	3,536	−14.7	58	28	3,755	2.6	44
600	28	4,134	−15.7	37	28	4,250	−12.2	43	28	4,351	−5.5	----	27	4,310	−8.0	----	28	4,036	−21.0	----	28	4,136	−18.7	56	28	4,397	−1.9	44
550	28	4,790	−19.2	----	28	4,910	−16.4	40	28	5,028	−9.5	----	27	4,981	−12.6	----	27	4,671	−25.3	----	28	4,779	−23.1	----	28	5,082	−6.1	40
500	27	5,491	−23.6	----	28	5,619	−21.4	----	28	5,759	−14.0	----	27	5,698	−17.5	----	27	5,354	−29.8	----	28	5,470	−27.9	----	27	5,830	−10.8	39
450	27	6,258	−28.9	----	28	6,389	−26.9	----	28	6,557	−19.3	----	27	6,483	−22.8	----	27	6,103	−35.2	----	27	6,220	−33.2	----	27	6,634	−16.3	39
400	27	7,086	−34.9	----	28	7,227	−33.2	----	28	7,416	−25.2	----	27	7,333	−29.1	----	26	6,903	−41.0	----	27	7,033	−38.6	----	27	7,500	−22.5	----
350	27	8,004	−41.4	----	28	8,152	−39.8	----	28	8,371	−32.6	----	27	8,274	−35.8	----	26	7,798	−47.2	----	27	7,938	−44.6	----	27	8,465	−29.7	----
300	27	9,034	−48.2	----	28	9,189	−47.0	----	28	9,438	−40.9	----	27	9,329	−43.2	----	26	8,806	−51.9	----	27	8,954	−51.1	----	26	9,550	−38.1	----
250	27	10,216	−54.7	----	28	10,378	−53.3	----	28	10,651	−50.8	----	27	10,534	−51.5	----	23	9,973	−55.0	----	26	10,118	−55.9	----	25	10,782	−47.5	----
200	22	11,586	−56.7	----	28	11,804	−55.4	----	26	12,072	−58.4	----	26	11,968	−55.7	----	17	11,391	−54.6	----	26	11,535	−55.4	----	23	12,230	−55.6	----
175	21	12,438	−54.5	----	26	12,661	−54.3	----	21	12,902	−59.5	----	26	12,817	−56.2	----	15	12,256	−52.9	----	24	12,394	−52.9	----	21	13,077	−59.1	----
150	20	13,421	−54.0	----	26	13,646	−55.4	----	19	13,858	−61.2	----	24	13,799	−58.2	----	13	13,250	−51.8	----	22	13,390	−52.2	----	16	14,042	−62.8	----
125	17	14,574	−54.4	----	20	14,783	−57.8	----	15	14,996	−64.0	----	23	14,934	−61.4	----	9	14,435	−50.5	----	19	14,574	−53.4	----	10	15,171	−66.6	----
100	11	16,002	−56.3	----	9	16,154	−59.8	----	9	16,341	−68.7	----	21	16,304	−63.9	----	----	----	----	----	18	16,000	−54.6	----	5	16,474	−71.2	----
80	5	17,434	−57.1	----	----	----	----	----	----	----	----	----	13	17,668	−64.7	----	----	----	----	----	10	17,442	−56.0	----	----	----	----	----

Standard pressure surface (mb.)	Buffalo, N. Y. (992.3 mb.)				Camaguey, Cuba. (1,006.3 mb.)				Caribou, Maine (994.5 mb.)				Charleston, S. C. (1,020.8 mb.)				Ciudad Victoria, Mex. (976.3 mb.)				Columbia, Mo. (990.5 mb.)				Dodge City, Kans. (925.0 mb.)			
Surface	27	221	−0.8	73	26	122	20.4	86	28	191	−11.8	75	28	13	12.5	85	27	335	22.9	52	26	239	0.8	74	28	792	−0.4	79
1,000	27	158	(*)	----	26	177	20.9	83	28	147	(*)	----	28	186	13.9	78	27	124	(*)	----	26	160	(*)	----	28	161	(*)	----
950	27	573	−1.7	69	26	623	19.3	76	28	545	−10.6	69	28	624	13.1	70	27	575	20.9	55	26	577	1.2	63	28	579	(*)	----
900	27	996	−3.3	64	26	1,085	17.2	66	28	957	−11.1	65	28	1,073	11.1	64	27	1,037	17.9	62	26	1,009	1.7	56	28	1,011	.6	66
850	27	1,447	−5.0	60	26	1,572	14.4	64	28	1,395	−12.0	62	28	1,549	9.2	55	27	1,524	15.0	67	26	1,469	.6	51	28	1,471	1.7	55
800	27	1,923	−6.4	56	26	2,081	11.7	55	28	1,858	−12.7	59	28	2,050	7.8	45	27	2,037	12.9	64	26	1,954	−.9	50	28	1,960	1.4	43
750	27	2,435	−7.8	53	26	2,625	11.0	----	28	2,354	−13.7	54	28	2,587	5.4	42	27	2,583	10.3	62	26	2,468	−3.3	48	28	2,481	−1.4	36
700	27	2,960	−10.6	52	26	3,195	9.5	----	28	2,872	−15.8	52	28	3,141	2.5	37	27	3,149	7.3	55	26	3,010	−5.7	43	28	3,023	−4.8	35
650	27	3,533	−13.3	53	26	3,810	6.2	----	28	3,431	−18.5	51	28	3,739	−1.1	----	27	3,759	3.3	53	26	3,593	−8.7	39	28	3,607	−8.3	33
600	27	4,133	−16.5	48	26	4,457	2.1	----	28	4,021	−21.5	----	28	4,371	−4.7	----	27	4,400	−.9	50	26	4,205	−12.0	35	28	4,218	−12.3	----
550	27	4,788	−20.5	----	26	5,155	−2.7	----	28	4,660	−24.7	----	27	5,049	−8.9	----	27	5,092	−5.1	40	26	4,868	−16.1	----	28	4,880	−16.8	----
500	26	5,478	−24.7	----	26	5,902	−7.9	----	28	5,346	−28.8	----	27	5,780	−13.2	----	27	5,833	−9.6	----	26	5,576	−21.0	----	23	5,586	−21.8	----
450	26	6,242	−29.7	----	26	6,716	−13.9	----	28	6,100	−33.3	----	27	6,583	−18.5	----	27	6,649	−14.9	----	24	6,359	−26.3	----	28	6,359	−27.4	----
400	26	7,067	−34.9	----	26	7,596	−20.8	----	28	6,912	−38.5	----	26	7,448	−24.6	----	26	7,520	−21.1	----	24	7,193	−32.4	----	28	7,190	−33.6	----
350	26	7,987	−40.9	----	26	8,568	−28.2	----	28	7,818	−44.2	----	26	8,405	−31.9	----	25	8,492	−28.3	----	23	8,119	−39.4	----	28	8,111	−40.9	----
300	25	9,030	−47.6	----	26	9,654	−36.6	----	28	8,838	−49.5	----	25	9,482	−40.2	----	24	9,582	−36.8	----	23	9,158	−46.6	----	26	9,140	−48.4	----
250	18	10,233	−54.7	----	25	10,892	−45.8	----	27	10,012	−53.4	----	25	10,699	−50.2	----	23	10,818	−47.1	----	16	10,392	−53.4	----	26	10,322	−54.2	----
200	14	11,653	−57.1	----	24	12,343	−55.4	----	24	11,431	−54.2	----	22	12,143	−58.1	----	21	12,270	−55.4	----	----	----	----	----	18	11,737	−55.8	----
175	9	12,527	−55.8	----	24	13,184	−60.6	----	21	12,269	−52.8	----	19	12,969	−59.8	----	14	13,119	−59.9	----	----	----	----	----	14	12,607	−55.4	----
150	----	----	----	----	24	14,130	−66.2	----	18	13,273	−52.7	----	13	13,934	−62.0	----	----	----	----	----	----	----	----	----	12	13,593	−56.4	----
125	----	----	----	----	23	15,217	−72.3	----	13	14,446	−52.3	----	6	15,042	−67.4	----	----	----	----	----	----	----	----	----	10	14,753	−59.0	----
100	----	----	----	----	10	16,523	−75.8	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	6	16,143	−61.3	----

Standard pressure surface (mb.)	El Paso, Tex. (881.5 mb.)				Ely, Nev. (806.0 mb.)				Glasgow, Mont. (937.6 mb.)				Grand Junction, Colo. (852.6 mb.)				Great Falls, Mont. (880.8 mb.)				Greensboro, N. C. (989.8 mb.)				Hatteras, N. C. (1,022.5 mb.)			
Surface	28	1,195	10.1	38	28	1,908	−9.2	74	28	648	−15.8	65	28	1,474	−6.4	72	28	1,128	−8.2	65	28	273	7.4	79	28	3	11.6	82
1,000	28	128	(*)	----	28	196	(*)	----	28	155	(*)	----	28	207	(*)	----	28	129	(*)	----	28	188	(*)	----	28	189	12.1	76
950	28	570	(*)	----	28	610	(*)	----	28	550	(*)	----	28	622	(*)	----	28	542	(*)	----	28	616	8.6	64	28	624	10.3	67
900	28	1,025	(*)	----	28	1,040	(*)	----	28	958	−11.7	66	28	1,050	(*)	----	28	965	(*)	----	28	1,059	6.8	63	28	1,067	8.5	59
850	28	1,499	10.4	33	28	1,491	(*)	----	28	1,398	−9.8	59	28	1,498	(*)	----	28	1,404	−7.2	55	28	1,527	5.4	54	28	1,538	6.6	50
800	28	2,000	6.9	36	28	1,967	(*)	----	28	1,865	−10.8	57	28	1,978	−2.9	52	28	1,875	−9.0	53	28	2,021	3.6	53	28	2,034	4.9	38
750	28	2,530	3.1	39	28	2,478	−6.5	57	28	2,366	−12.2	56	28	2,490	−4.9	51	28	2,379	−10.9	56	28	2,546	1.9	44	28	2,564	2.7	36
700	28	3,082	−.7	38	28	3,010	−9.8	55	28	2,885	−14.8	55	28	3,026	−8.7	54	28	2,901	−13.4	56	28	3,098	−.5	41	28	3,113	.1	36
650	28	3,669	−4.9	36	28	3,584	−13.1	51	28	3,448	−18.0	55	28	3,601	−12.2	54	28	3,465	−16.7	50	28	3,688	−3.6	----	27	3,705	−3.0	----
600	28	4,293	−9.3	----	28	4,183	−16.3	47	28	4,036	−21.5	----	28	4,205	−15.6	49	28	4,058	−20.7	----	28	4,315	−7.6	----	27	4,335	−6.8	----
550	27	4,964	−13.8	----	28	4,836	−20.6	----	28	4,673	−25.7	----	28	4,859	−19.9	48	28	4,695	−25.1	----	28	4,968	−11.8	----	27	5,007	−11.1	----
500	27	5,681	−18.7	----	28	5,532	−25.2	----	28	5,356	−30.7	----	28	5,557	−24.7	----	28	5,380	−30.0	----	27	5,705	−16.9	----	27	5,732	−15.7	----
450	27	6,463	−24.3	----	28	6,294	−30.5	----	27	6,094	−36.4	----	28	6,320	−30.2	----	28	6,127	−35.5	----	27	6,494	−22.0	----	27	6,521	−21.1	----
400	26	7,308	−30.8	----	28	7,117	−36.4	----	26	6,802	−42.1	----	27	7,149	−36.1	----	28	6,931	−41.5	----	27	7,345	−27.8	----	27	7,380	−26.2	----
350	26	8,243	−37.6	----	28	8,028	−43.5	----	26	7,783	−48.1	----	27	8,063	−42.6	----	28	7,824	−47.6	----	27	8,288	−34.4	----	25	8,328	−33.7	----
300	24	9,298	−44.9	----	27	9,050	−51.1	----	25	8,796	−52.9	----	23	9,069	−49.9	----	26	8,849	−53.0	----	25	9,355	−41.8	----	23	9,387	−41.5	----
250	21	10,487	−53.1	----	26	10,224	−56.3	----	24	9,956	−55.7	----	22	10,252	−54.8	----	25	10,017	−57.6	----	22	10,585	−50.9	----	22	10,595	−50.9	----
200	18	11,908	−56.2	----	22	11,652	−56.7	----	19	11,354	−53.5	----	19	11,663	−54.2	----	21	11,425	−57.0	----	20	12,016	−58.0	----	19	12,012	−57.1	----
175	16	12,756	−55.6	----	20	12,501	−55.8	----	18	12,205	−51.6	----	13	12,503	−52.0	----	16	12,275	−53.6	----	17	12,867	−58.9	----	10	12,855	−56.7	----
150	11	13,744	−57.4	----	19	13,489	−55.8	----	14	13,194	−51.0	----	10	13,511	−52.6	----	15	13,262	−51.9	----	10	13,821	−59.7	----	9	13,847	−59.5	----
125	7	14,882	−60.6	----	17	14,655	−58.2	----	11	14,372	−51.5	----	5	14,679	−54.7	----	14	14,446	−52.1	----	7	14,946	−60.7	----	----	----	----	----
100	----	----	----	----	12	16,069	−58.8	----	6	15,848	−49.6	----	----	----	----	----	13	15,894	−52.3	----	----	----	----	----	----	----	----	----
80	----	----	----	----	5	17,475	−61.0	----	----	----	----	----	----	----	----	----	10	17,339	−52.2	----	----	----	----	----	----	----	----	----

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during February, 1949*—Continued

Standard pressure surface (mb.)	Havana, Cuba.[1] (mb.)				Honolulu, T. H. (1,015.2 mb.)				International Falls, Minn. (973.0 mb.)				Joliet, Ill. (997.8 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	----	----	----	----	28	3	24.0	68	28	360	−16.5	73	28	178	−3.0	79
1,000	----	----	----	----	28	135	22.2	70	28	152	(*)	----	28	150	−4.1	73
950	----	----	----	----	28	579	18.5	75	28	541	−15.0	69	28	568	−3.1	70
900	----	----	----	----	28	1,041	14.9	81	28	948	−15.6	68	28	994	−2.9	60
850	----	----	----	----	28	1,523	12.7	73	28	1,380	−14.2	66	28	1,447	−3.1	53
800	----	----	----	----	28	2,031	11.5	52	28	1,840	−14.1	62	28	1,926	−4.6	51
750	----	----	----	----	28	2,572	8.6	47	28	2,333	−15.6	58	28	2,438	−6.6	42
700	----	----	----	----	28	3,135	6.2	41	28	2,846	−17.6	55	28	2,969	−9.1	42
650	----	----	----	----	28	3,741	2.8	37	28	3,407	−20.5	----	28	3,548	−12.3	41
600	----	----	----	----	28	4,382	−.1	----	28	3,986	−23.9	----	28	4,146	−15.6	36
550	----	----	----	----	28	5,070	−5.4	----	28	4,621	−27.4	----	28	4,802	−19.1	31
500	----	----	----	----	28	5,813	−9.8	----	28	5,295	−31.8	----	28	5,502	−23.8	----
450	----	----	----	----	28	6,623	−15.2	----	28	6,036	−36.7	----	28	6,267	−29.0	----
400	----	----	----	----	28	7,498	−21.6	----	28	6,840	−41.5	----	28	7,096	−34.8	----
350	----	----	----	----	28	8,467	−28.5	----	28	7,735	−46.7	----	28	8,015	−41.3	----
300	----	----	----	----	28	9,553	−36.3	----	28	8,743	−52.3	----	28	9,046	−47.9	----
250	----	----	----	----	28	10,796	−44.5	----	28	9,912	−54.8	----	28	10,233	−53.6	----
200	----	----	----	----	28	12,259	−53.9	----	23	11,332	−53.7	----	28	11,657	−55.9	----
175	----	----	----	----	28	13,107	−58.9	----	23	12,191	−52.6	----	28	12,508	−55.0	----
150	----	----	----	----	28	14,062	−63.5	----	23	13,187	−52.6	----	28	13,492	−55.3	----
125	----	----	----	----	28	15,160	−67.8	----	19	14,360	−52.9	----	25	14,643	−56.9	----
100	----	----	----	----	27	16,497	−72.6	----	10	15,798	−51.7	----	19	16,046	−58.4	----
80	----	----	----	----	26	17,805	−72.2	----	6	17,271	−49.7	----	12	17,422	−55.7	----
60	----	----	----	----	26	19,526	−64.5	----	----	----	----	----	----	----	----	----
50	----	----	----	----	21	20,654	−59.9	----	----	----	----	----	----	----	----	----
40	----	----	----	----	20	22,063	−55.8	----	----	----	----	----	----	----	----	----
30	----	----	----	----	18	23,912	−51.8	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Lake Charles, La. (1,019.6 mb.)				Lander, Wyo. (823.3 mb.)				Las Vegas, Nev. (939.8 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	5	14.0	87	28	1,696	−7.1	56	28	660	5.1	54
1,000	28	169	14.3	81	28	151	(*)	----	28	146	(*)	----
950	28	606	13.5	72	28	568	(*)	----	28	574	(*)	----
900	28	1,057	12.6	64	28	998	(*)	----	28	1,015	6.4	46
850	28	1,537	10.9	59	28	1,446	(*)	----	28	1,481	3.1	43
800	28	2,040	8.5	56	28	1,922	−3.9	46	28	1,970	.3	44
750	28	2,576	6.0	50	28	2,435	−6.4	40	28	2,488	−2.9	46
700	28	3,134	3.1	49	28	2,966	−9.6	39	28	3,028	−6.0	44
650	27	3,733	−.2	42	28	3,542	−13.0	39	28	3,608	−9.6	40
600	27	4,368	−4.5	----	28	4,140	−17.0	37	28	4,218	−13.7	38
550	26	5,048	−8.8	----	28	4,791	−21.6	----	28	4,874	−18.1	35
500	26	5,780	−13.5	----	28	5,482	−26.6	----	28	5,578	−23.1	----
450	26	6,579	−18.8	----	28	6,243	−32.3	----	28	6,345	−29.1	----
400	26	7,441	−25.1	----	28	7,056	−38.5	----	28	7,172	−35.2	----
350	25	8,393	−32.4	----	28	7,959	−45.3	----	28	8,080	−42.0	----
300	25	9,461	−40.6	----	27	8,980	−52.3	----	28	9,117	−49.0	----
250	25	10,677	−50.3	----	23	10,154	−58.0	----	28	10,296	−55.1	----
200	24	12,108	−57.5	----	20	11,570	−57.6	----	25	11,700	−56.3	----
175	24	12,946	−59.9	----	16	12,433	−54.7	----	24	12,546	−54.2	----
150	21	13,907	−62.8	----	14	13,433	−54.4	----	23	13,538	−55.3	----
125	17	15,006	−66.7	----	11	14,590	−55.2	----	21	14,689	−57.4	----
100	10	16,338	−70.6	----	7	15,989	−54.8	----	14	16,076	−58.5	----
80	6	17,659	−71.1	----	----	----	----	----	9	17,451	−57.7	----
60	----	----	----	----	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----	----	----	----	----
40	----	----	----	----	----	----	----	----	----	----	----	----
30	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Little Rock, Ark. (1,011.2 mb.)				Mazatlan, Mex. (1,011.3 mb.)				Medford, Oreg. (968.9 mb.)				Merida, Mex. (1,013.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	79	8.3	77	28	14	19.9	78	28	401	4.2	81	28	27	25.4	71
1,000	28	171	8.9	69	28	111	19.8	71	28	143	(*)	----	28	145	24.8	71
950	28	597	8.7	64	28	565	21.9	38	28	565	4.8	71	28	594	22.7	67
900	28	1,043	7.4	57	28	1,022	19.9	36	28	1,000	2.4	66	28	1,064	19.5	71
850	28	1,513	6.6	45	28	1,512	16.7	36	28	1,460	−1.0	69	28	1,554	16.1	75
800	28	2,009	5.0	39	28	2,025	13.2	37	28	1,941	−4.3	72	28	2,066	12.4	78
750	28	2,539	2.8	35	28	2,574	9.2	40	28	2,451	−7.1	67	28	2,608	9.8	64
700	28	3,088	−.1	34	28	3,131	5.2	41	28	2,982	−10.1	61	28	3,178	8.8	----
650	28	3,681	−3.5	----	28	3,734	1.4	43	28	3,553	−13.3	54	28	3,789	6.4	----
600	26	4,304	−7.5	----	27	4,373	−3.0	50	28	4,154	−17.1	48	27	4,440	2.3	----
550	26	4,977	−11.8	----	27	5,057	−7.2	47	28	4,802	−21.1	----	26	5,131	−2.1	----
500	26	5,698	−16.9	----	27	5,793	−12.0	44	28	5,499	−25.5	----	26	5,886	−7.6	----
450	25	6,484	−22.8	----	25	6,601	−16.4	47	28	6,263	−30.8	----	26	6,702	−13.4	----
400	25	7,332	−28.7	----	25	7,470	−22.4	----	28	7,081	−36.7	----	26	7,583	−20.1	----
350	25	8,275	−35.2	----	25	8,436	−29.7	----	28	7,994	−43.0	----	26	8,556	−28.1	----
300	25	9,332	−42.8	----	25	9,517	−37.7	----	27	9,011	−49.6	----	26	9,642	−36.7	----
250	25	10,538	−51.5	----	24	10,751	−47.1	----	27	10,187	−55.2	----	26	10,878	−46.6	----
200	24	11,963	−57.4	----	24	12,195	−56.4	----	23	11,614	−56.2	----	26	12,321	−57.2	----
175	20	12,797	−56.1	----	23	13,040	−58.9	----	17	12,456	−54.1	----	25	13,152	−62.5	----
150	18	13,765	−58.4	----	22	13,994	−62.9	----	13	13,474	−54.0	----	24	14,087	−61.8	----
125	14	14,900	−60.4	----	18	15,106	−68.3	----	9	14,654	−54.6	----	22	15,167	−73.8	----
100	8	16,270	−61.5	----	15	16,425	−73.1	----	7	16,108	−56.6	----	13	16,433	−78.6	----
80	5	17,636	−62.3	----	7	17,740	−73.4	----	5	17,526	−56.2	----	6	17,714	−78.8	----

Standard pressure surface (mb.)	Miami, Fla. (1,020.8 mb.)				Nantucket, Mass. (1,018.4 mb.)				Nashville, Tenn. (1,000.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	4	22.2	77	28	14	1.8	82	28	177	6.8	73
1,000	28	183	21.9	74	28	160	2.1	76	28	179	(*)	----
950	28	628	19.0	72	28	575	.8	66	28	604	6.4	67
900	28	1,090	15.9	68	28	1,007	−.5	63	28	1,044	5.7	58
850	28	1,574	12.8	67	28	1,462	−2.2	55	28	1,510	4.2	48
800	28	2,081	11.1	50	28	1,943	−3.4	48	28	2,002	2.7	42
750	28	2,624	9.8	28	28	2,458	−4.9	45	28	2,525	.4	39
700	28	3,189	7.5	----	28	2,992	−7.1	43	28	3,073	−1.9	----
650	28	3,800	4.7	----	28	3,569	−10.0	40	28	3,664	−5.4	----
600	28	4,444	1.1	----	28	4,180	−13.3	38	28	4,281	−9.1	----
550	28	5,140	−3.5	----	27	4,836	−17.3	----	28	4,953	−13.4	----
500	28	5,882	−9.1	----	26	5,551	−21.9	----	28	5,668	−18.0	----
450	28	6,695	−14.9	----	26	6,321	−27.2	----	28	6,450	−23.5	----
400	28	7,570	−21.4	----	26	7,157	−33.2	----	28	7,299	−29.3	----
350	27	8,538	−29.2	----	25	8,090	−39.6	----	28	8,240	−35.7	----
300	27	9,619	−38.0	----	24	9,126	−46.7	----	26	9,283	−43.2	----
250	25	10,847	−47.3	----	23	10,309	−53.8	----	25	10,497	−51.9	----
200	22	12,293	−55.8	----	20	11,731	−57.3	----	23	11,914	−57.6	----
175	20	13,138	−59.3	----	19	12,578	−55.9	----	20	12,759	−58.2	----
150	17	14,090	−64.3	----	18	13,561	−55.2	----	18	13,717	−58.7	----
125	11	15,181	−69.1	----	16	14,709	−56.9	----	8	14,815	−59.5	----
100	6	16,501	−74.0	----	15	16,117	−58.8	----	5	16,183	−62.3	----
80	----	----	----	----	8	17,508	−58.5	----	----	----	----	----

Standard pressure surface (mb.)	New Orleans, La. (1,020.1 mb.)				North Platte, Nebr. (916.8 mb.)				Oakland, Calif. (1,018.9 mb.)				Oklahoma City, Okla. (972.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	2	15.5	86	28	849	−5.1	72	28	6	9.0	79	28	391	3.5	81
1,000	28	171	15.7	81	28	157	(*)	----	28	161	8.3	77	28	166	(*)	----
950	28	607	14.8	69	28	568	(*)	----	28	585	5.8	73	28	586	3.9	75
900	28	1,064	13.2	59	28	994	−2.9	65	28	1,025	3.8	65	28	1,025	5.3	62
850	28	1,543	11.4	60	28	1,448	−2.2	50	28	1,487	1.5	58	28	1,491	4.4	54
800	28	2,048	9.2	57	28	1,929	−3.3	44	28	1,973	−1.0	51	28	1,984	2.6	45
750	28	2,582	6.4	54	28	2,442	−5.6	41	28	2,492	−3.5	49	28	2,508	.4	41
700	28	3,143	3.4	52	28	2,974	−8.9	42	28	3,028	−6.5	49	28	3,055	−2.5	38
650	26	3,739	.0	47	28	3,550	−12.6	44	27	3,610	−10.0	49	28	3,641	−6.2	39
600	26	4,375	−3.8	42	28	4,151	−16.5	41	27	4,218	−13.9	45	28	4,260	−10.0	----
550	26	5,057	−7.9	----	28	4,803	−20.3	36	27	4,876	−18.6	43	28	4,928	−14.5	----
500	26	5,793	−12.4	----	28	5,500	−25.1	----	27	5,578	−23.2	----	28	5,641	−19.6	----
450	26	6,595	−18.2	----	27	6,256	−30.9	----	27	6,347	−28.5	----	27	6,416	−25.6	----
400	26	7,460	−24.5	----	27	7,077	−37.3	----	27	7,174	−34.9	----	26	7,259	−31.5	----
350	26	8,418	−31.8	----	23	7,999	−43.4	----	27	8,092	−41.7	----	23	8,210	−37.8	----
300	26	9,488	−40.4	----	22	9,029	−49.6	----	27	9,120	−48.8	----	20	9,273	−44.9	----
250	25	10,707	−50.1	----	19	10,241	−54.3	----	26	10,310	−55.4	----	15	10,449	−53.3	----
200	24	12,132	−58.0	----	18	11,675	−56.4	----	26	11,720	−56.7	----	12	11,849	−55.0	----
175	21	12,970	−60.8	----	16	12,519	−54.1	----	25	12,561	−55.5	----	10	12,689	−54.8	----
150	19	13,923	−63.2	----	12	13,530	−54.9	----	23	13,552	−55.4	----	6	13,677	−55.8	----
125	16	15,033	−66.9	----	7	14,668	−57.4	----	21	14,707	−57.1	----	5	14,838	−59.6	----
100	10	16,389	−70.4	----	----	----	----	----	16	16,096	−58.4	----	----	----	----	----
80	----	----	----	----	----	----	----	----	8	17,471	−57.7	----	----	----	----	----

Standard pressure surface (mb.)	Omaha, Nebr. (982.2 mb.)				Phoenix, Ariz. (976.8 mb.)				Pittsburgh, Pa (974.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	308	−5.0	76	28	339	11.2	49	28	382	2.3	73
1,000	28	165	(*)	----	28	140	(*)	----	28	170	(*)	----
950	28	574	−5.9	70	28	576	13.4	32	28	592	2.1	66
900	28	992	−4.6	66	28	1,024	10.0	34	28	1,022	.5	62
850	28	1,444	−3.0	57	28	1,496	6.3	37	28	1,479	−1.0	58
800	28	1,923	−3.5	48	28	1,989	2.7	40	28	1,961	−2.9	54
750	28	2,436	−5.7	43	28	2,512	−.9	39	28	2,479	−4.9	50
700	28	2,969	−8.6	41	28	3,055	−4.3	37	28	3,011	−7.5	49
650	28	3,545	−12.2	40	28	3,638	−7.8	----	28	3,592	−10.6	50
600	28	4,148	−16.1	40	28	4,252	−12.0	----	28	4,197	−13.8	48
550	28	4,798	−20.4	----	28	4,915	−16.7	----	27	4,857	−17.8	43
500	28	5,498	−24.7	----	28	5,621	−22.0	----	27	5,557	−21.8	----
450	27	6,266	−29.5	----	28	6,395	−27.6	----	27	6,337	−27.0	----
400	27	7,093	−35.3	----	28	7,226	−33.5	----	27	7,165	−32.9	----
350	27	8,010	−41.9	----	28	8,149	−40.3	----	25	8,081	−39.5	----
300	26	9,044	−49.2	----	28	9,184	−47.5	----	22	9,114	−46.3	----
250	26	10,223	−55.3	----	28	10,370	−54.0	----	18	10,324	−53.3	----
200	23	11,645	−56.1	----	27	11,787	−55.5	----	11	11,783	−56.1	----
175	21	12,494	−55.0	----	25	12,627	−55.0	----	6	12,614	−53.4	----
150	15	13,511	−54.9	----	24	13,616	−56.2	----	----	----	----	----
125	10	14,665	−56.0	----	24	14,760	−58.8	----	----	----	----	----
100	6	16,039	−56.4	----	19	16,147	−60.4	----	----	----	----	----
80	5	17,464	−57.8	----	12	17,511	−60.4	----	----	----	----	----

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TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during February, 1949*—Continued

Standard pressure surface (mb.)	Portland, Maine (1,017.1 mb.)				Rapid City, S. Dak. (899.8 mb.)				St. Cloud, Minn. (978.7 mb.)				San Antonio, Tex. (990.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	20	−3.5	73	28	980	−9.2	70	28	317	−12.6	76	28	240	13.1	76
1,000	28	154	−3.0	66	28	152	(*)	----	28	151	(*)	----	28	157	(*)	----
950	28	564	−4.0	61	28	557	(*)	----	28	548	−11.6	72	28	505	13.3	71
900	28	985	−5.3	59	28	980	(*)	----	28	958	−10.2	66	28	1,045	12.1	68
850	28	1,433	−6.1	57	28	1,425	−6.2	60	28	1,399	−9.8	60	28	1,523	11.2	60
800	28	1,906	−7.0	49	28	1,899	−6.7	52	28	1,867	−9.6	54	28	2,029	9.4	51
750	28	2,414	−8.8	44	28	2,403	−8.4	49	28	2,369	−11.2	54	28	2,565	6.8	45
700	28	2,940	−10.9	44	28	2,933	−11.5	47	28	2,891	−13.8	54	28	3,125	3.2	40
650	28	3,515	−13.4	41	28	3,502	−14.6	45	28	3,456	−16.8	53	28	3,723	−.9	36
600	28	4,113	−16.8	41	27	4,096	−18.6	42	28	4,048	−20.1	49	28	4,355	−5.0	35
550	28	4,764	−20.7	----	27	4,740	−22.8	----	28	4,689	−24.0	----	28	5,036	−9.6	34
500	28	5,460	−25.0	----	27	5,432	−27.8	----	28	5,384	−28.1	----	28	5,762	−14.6	38
450	28	6,220	−30.2	----	27	6,186	−33.3	----	27	6,137	−33.2	----	27	6,564	−19.6	39
400	28	7,046	−36.1	----	27	6,997	−39.5	----	27	6,950	−38.7	----	27	7,418	−25.4	----
350	28	7,960	−42.4	----	26	7,904	−45.5	----	26	7,859	−44.7	----	27	8,373	−32.4	----
300	25	8,992	−48.8	----	26	8,919	−51.1	----	26	8,877	−50.2	----	27	9,442	−40.3	----
250	23	10,181	−55.1	----	21	10,108	−54.5	----	26	10,053	−54.6	----	25	10,672	−49.2	----
200	21	11,597	−56.8	----	19	11,515	−54.8	----	15	11,513	−55.6	----	20	12,113	−56.6	----
175	19	12,449	−55.3	----	17	12,353	−52.2	----	12	12,413	−55.6	----	16	12,957	−58.4	----
150	17	13,443	−55.4	----	16	13,345	−52.0	----	12	13,395	−54.6	----	15	13,925	−60.2	----
125	15	14,605	−55.8	----	11	14,489	−51.6	----	11	14,566	−54.3	----	8	15,058	−63.8	----
100	9	16,002	−58.3	----	----	----	----	----	9	16,006	−54.7	----	5	16,430	−68.0	----
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	San Juan, P. R. (1,017.5 mb.)				Santa Maria, Calif. (1,011.3 mb.)				Sault Ste. Marie, Mich. (989.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	15	23.3	77	28	71	8.9	78	28	221	−7.0	78
1,000	28	166	22.2	75	28	164	9.0	73	28	138	(*)	----
950	28	612	18.4	80	28	592	7.5	66	28	538	−8.5	79
900	28	1,072	15.0	80	28	1,031	5.1	62	28	956	−10.1	79
850	28	1,554	11.7	79	28	1,496	2.7	58	28	1,395	−11.6	76
800	28	2,059	9.6	66	28	1,984	.4	47	28	1,859	−12.1	72
750	28	2,604	9.9	----	28	2,506	−1.8	39	28	2,359	−13.8	70
700	28	3,106	7.8	----	28	3,046	−4.7	35	28	2,873	−15.7	67
650	27	3,775	4.5	----	28	3,628	−8.2	36	28	3,436	−18.4	61
600	26	4,419	.9	----	28	4,242	−12.3	34	28	4,022	−22.2	----
550	25	5,111	−3.6	----	28	4,904	−16.4	33	27	4,656	−26.3	----
500	25	5,859	−8.9	----	28	5,611	−21.3	----	26	5,346	−30.1	----
450	24	6,675	−14.9	----	28	6,388	−26.8	----	23	6,086	−35.4	----
400	24	7,546	−21.6	----	28	7,219	−33.1	----	20	6,908	−40.6	----
350	24	8,517	−28.2	----	27	8,137	−40.2	----	19	7,798	−46.4	----
300	24	9,605	−36.0	----	27	9,172	−47.3	----	15	8,827	−51.5	----
250	23	10,848	−44.7	----	27	10,357	−54.4	----	7	10,080	−57.0	----
200	22	12,311	−54.4	----	27	11,774	−56.8	----	5	11,474	−57.5	----
175	20	13,157	−60.1	----	27	12,623	−55.7	----	----	----	----	----
150	20	14,106	−66.0	----	26	13,600	−56.1	----	----	----	----	----
125	18	15,194	−71.9	----	26	14,754	−57.6	----	----	----	----	----
100	12	16,498	−77.0	----	24	16,147	−59.2	----	----	----	----	----
80	10	17,773	−78.9	----	22	17,543	−59.4	----	----	----	----	----
60	----	----	----	----	13	19,342	−58.0	----	----	----	----	----
50	----	----	----	----	8	20,505	−58.1	----	----	----	----	----

Standard pressure surface (mb.)	Spokane, Wash. (927.0 mb.)				Swan Island, W. I.[1]				Tacubaya, Mex. (773.5 mb.)				Tampa, Fla. (1,020.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	27	721	−3.7	86	----	----	----	----	28	2,306	16.6	40	28	9	19.2	85
1,000	27	117	(*)	----	----	----	----	----	28	54	(*)	----	28	184	19.8	77
950	27	525	(*)	----	----	----	----	----	28	518	(*)	----	28	629	18.0	68
900	27	956	−2.4	75	----	----	----	----	28	995	(*)	----	28	1,087	15.3	67
850	27	1,407	−5.0	68	----	----	----	----	28	1,490	(*)	----	28	1,570	12.2	67
800	27	1,881	−7.8	66	----	----	----	----	28	2,019	(*)	----	28	2,076	10.4	50
750	27	2,383	−10.8	69	----	----	----	----	28	2,570	15.2	42	28	2,616	7.8	45
700	27	2,907	−13.9	64	----	----	----	----	28	3,149	10.7	47	28	3,178	5.4	39
650	27	3,472	−17.1	60	----	----	----	----	28	3,763	5.7	54	28	3,786	2.6	32
600	27	4,064	−20.8	----	----	----	----	----	28	4,411	.4	62	27	4,424	−1.1	----
550	27	4,703	−24.6	----	----	----	----	----	28	5,107	−4.2	44	27	5,112	−5.4	----
500	27	5,389	−29.4	----	----	----	----	----	27	5,848	−8.5	----	27	5,852	−10.6	----
450	26	6,142	−34.5	----	----	----	----	----	27	6,669	−13.6	----	27	6,661	−16.1	----
400	26	6,950	−40.1	----	----	----	----	----	27	7,545	−19.6	----	26	7,531	−22.6	----
350	26	7,850	−45.8	----	----	----	----	----	27	8,520	−27.5	----	26	8,496	−30.2	----
300	25	8,865	−51.3	----	----	----	----	----	27	9,610	−36.0	----	26	9,572	−39.0	----
250	23	10,023	−55.4	----	----	----	----	----	26	10,851	−45.2	----	24	10,795	−48.9	----
200	15	11,390	−52.8	----	----	----	----	----	25	12,312	−55.5	----	22	12,239	−57.2	----
175	11	12,245	−51.5	----	----	----	----	----	25	13,153	−60.8	----	19	13,066	−60.7	----
150	9	13,234	−48.1	----	----	----	----	----	23	14,100	−65.7	----	18	14,020	−65.0	----
125	7	14,417	−48.0	----	----	----	----	----	19	15,178	−71.7	----	16	15,119	−70.0	----
100	6	15,905	−49.2	----	----	----	----	----	16	16,485	−76.6	----	11	16,441	−74.2	----
80	----	----	----	----	----	----	----	----	9	17,769	−78.3	----	7	17,740	−75.8	----

Standard pressure surface (mb.)	Tatoosh Island, Wash. (1,006.2 mb.)				Toledo, Ohio (996.2 mb.)				Washington, D. C. (1,018.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	28	31	3.6	84	28	191	−0.6	81	28	25	6.1	66
1,000	28	81	3.2	81	28	160	(*)	----	28	178	5.9	61
950	28	497	1.6	78	28	574	−.5	71	28	600	4.5	57
900	28	930	−1.1	78	28	1,002	−1.7	61	28	1,035	2.4	57
850	28	1,383	−3.9	77	28	1,456	−2.7	54	28	1,496	1.1	56
800	28	1,860	−6.5	71	28	1,936	−4.5	50	28	1,982	−.3	53
750	28	2,364	−9.0	64	28	2,447	−6.6	47	28	2,503	−2.1	46
700	28	2,892	−12.0	57	28	2,979	−9.2	44	28	3,043	−4.9	45
650	28	3,461	−15.2	58	28	3,555	−12.2	40	28	3,628	−7.6	45
600	28	4,057	−18.8	55	28	4,157	−15.6	40	28	4,242	−11.0	40
550	28	4,701	−22.7	----	27	4,816	−19.0	36	28	4,907	−15.5	40
500	28	5,394	−26.9	----	27	5,518	−23.5	----	28	5,617	−20.1	----
450	28	6,150	−31.8	----	27	6,285	−28.9	----	28	6,398	−25.1	----
400	28	6,969	−37.8	----	27	7,113	−34.9	----	28	7,236	−31.0	----
350	28	7,877	−43.6	----	26	8,037	−41.3	----	28	8,169	−37.6	----
300	28	8,899	−49.9	----	24	9,090	−47.8	----	28	9,215	−45.1	----
250	27	10,068	−55.0	----	23	10,278	−55.0	----	28	10,411	−52.5	----
200	24	11,486	−55.0	----	22	11,677	−57.5	----	28	11,834	−56.9	----
175	22	12,344	−52.6	----	22	12,522	−56.1	----	25	12,677	−56.6	----
150	21	13,331	−51.6	----	18	13,474	−55.9	----	23	13,645	−57.2	----
125	18	14,516	−51.4	----	14	14,621	−56.5	----	17	14,779	−58.7	----
100	14	15,963	−52.0	----	11	16,016	−56.5	----	7	16,158	−60.1	----
80	10	17,433	−51.7	----	5	17,416	−56.5	----	----	----	----	----

See footnotes at end of table.

LATE REPORTS FROM SWAN ISLAND, W. I., FOR DECEMBER 1948 AND JANUARY 1949

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes*—Continued

Standard pressure surface (mb.)	Swan Island, W. I. (1,014.3 mb.)				Swan Island, W. I. (1,016.1 mb.)			
Surface	31	10	25.8	81	30	10	25.0	75
1,000	31	135	25.6	78	30	150	24.3	74
950	31	590	22.1	82	30	601	20.6	79
900	31	1,056	19.2	76	30	1,064	17.3	76
850	31	1,546	16.1	72	30	1,550	14.0	73
800	31	2,059	13.0	68	30	2,061	11.9	58
750	31	2,606	10.7	55	30	2,604	10.0	33
700	31	3,173	8.1	42	30	3,170	8.2	----
650	31	3,788	5.2	33	29	3,784	6.1	----
600	31	4,431	2.1	----	29	4,431	2.5	----
550	31	5,129	−2.0	----	29	5,130	−1.3	----
500	31	5,880	−6.7	----	29	5,882	−6.1	----
450	31	6,701	−12.3	----	29	6,703	−12.2	----
400	31	7,584	−18.9	----	29	7,588	−19.0	----
350	31	8,564	−26.1	----	29	8,566	−27.1	----
300	31	9,650	−34.6	----	29	9,655	−36.3	----
250	30	10,906	−44.6	----	29	10,893	−46.1	----
200	30	12,363	−55.2	----	29	12,347	−55.4	----
175	30	13,203	−61.0	----	29	13,188	−60.2	----
150	30	14,148	−66.9	----	19	14,141	−65.6	----
125	28	15,232	−72.6	----	11	15,243	−71.1	----
100	23	16,532	−77.7	----	----	----	----	----
80	14	17,805	−79.0	----	----	----	----	----
60	5	19,475	−72.7	----	----	----	----	----

[1] Data not yet received.

(*) Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad Victoria, Mazatlan and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C. Relative humidity data, beginning with October 1, 1948, were computed, and expressed in these tables, on the basis of the vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T., during February 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	25	196	2.1	28	236	1.0	26	288	0.8	27	255	2.5	27	9	0.9	25	121	2.7	19	133	4.7
500	---	----	----	---	----	----	26	251	.8	---	----	----	---	----	----	---	----	----	19	138	6.2
1,000	25	198	4.2	---	----	----	25	227	2.1	---	----	----	27	273	2.8	25	126	3.0	13	167	8.4
1,500	21	226	6.4	---	----	----	22	264	4.9	27	240	6.8	25	283	5.2	25	197	2.5	11	188	5.8
2,000	19	245	10.9	28	224	2.1	21	279	7.3	27	263	9.4	24	281	7.6	25	237	4.2	---	----	----
2,500	19	243	11.5	28	247	4.2	18	272	10.7	25	273	11.3	22	281	9.8	23	246	6.1	---	----	----
3,000	17	253	12.7	25	258	7.2	16	279	12.5	23	277	12.6	22	279	11.6	17	257	5.4	---	----	----
4,000	16	250	17.7	23	265	13.2	13	280	17.0	22	287	15.0	17	280	16.1	14	248	4.8	---	----	----
5,000	15	248	20.7	19	260	16.7	---	----	----	19	286	14.1	13	292	15.5	12	231	6.0	---	----	----
6,000	14	246	25.3	18	260	17.8	---	----	----	15	287	12.8	---	----	----	10	240	2.4	---	----	----
8,000	---	----	----	16	260	18.2	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----
10,000	---	----	----	11	258	17.4	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----

Altitude (meters) m. s. l.	Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	24	283	3.5	28	225	1.3	26	244	1.3	26	246	2.2	28	325	1.8	28	238	3.3
500	24	262	5.4	28	197	2.7	26	234	3.2	26	239	3.8	---	----	----	---	----	----
1,000	19	259	6.8	21	276	6.0	24	246	5.4	20	230	7.1	---	----	----	---	----	----
1,500	16	267	10.5	20	282	9.0	24	264	7.6	19	243	9.6	---	----	----	28	245	3.8
2,000	15	281	13.0	17	293	13.4	21	273	9.7	18	253	11.6	28	300	2.8	28	248	5.0
2,500	12	283	15.7	16	290	14.9	19	274	11.9	17	255	14.5	27	267	3.6	27	246	7.5
3,000	10	289	15.7	13	294	15.6	19	275	14.5	16	259	16.8	27	271	6.6	27	248	10.4
4,000	---	----	----	13	295	20.9	14	275	18.7	13	266	21.6	27	273	10.4	25	251	13.5
5,000	---	----	----	11	291	26.7	13	276	20.7	12	267	26.9	25	272	16.1	23	251	17.8
6,000	---	----	----	---	----	----	11	279	24.0	---	----	----	24	263	17.8	19	250	20.4
8,000	---	----	----	---	----	----	---	----	----	---	----	----	17	269	26.3	13	261	25.1
10,000	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (663 m.)		
Surface	26	186	2.0	27	303	1.3	24	261	1.9	27	270	1.1	23	130	0.7	24	239	3.6	28	221	1.3
500	---	----	----	---	----	----	24	259	3.3	---	----	----	23	259	1.3	24	245	5.9	---	----	----
1,000	---	----	----	---	----	----	24	262	4.8	27	249	4.2	22	243	3.1	19	256	9.0	28	215	.9
1,500	---	----	----	27	303	1.4	23	262	7.2	27	263	9.4	21	254	5.6	17	262	11.8	28	243	2.2
2,000	26	215	1.8	27	267	1.4	19	283	11.4	24	275	10.1	19	261	7.5	16	265	13.3	27	251	3.3
2,500	25	232	2.7	27	224	3.7	19	284	13.8	22	281	11.4	17	266	9.7	15	265	14.9	27	263	5.0
3,000	25	248	4.4	25	237	6.6	19	284	15.6	20	287	11.2	15	261	12.3	15	269	16.9	25	258	5.3
4,000	21	259	7.1	20	271	9.6	17	281	20.4	---	----	----	10	267	15.2	14	263	21.4	22	263	6.8
5,000	17	290	6.7	18	278	13.0	14	277	27.5	---	----	----	---	----	----	13	272	26.0	22	266	8.5
6,000	14	299	10.9	15	272	14.0	---	----	----	---	----	----	---	----	----	10	269	30.5	18	268	11.0
8,000	12	298	11.3	13	279	16.8	---	----	----	---	----	----	---	----	----	---	----	----	12	308	10.5

Altitude (meters) m. s. l.	Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
Surface	27	90	0.3	26	273	1.4	28	127	4.1	24	162	0.5	26	204	0.8	26	270	2.5
500	27	217	1.0	26	248	1.2	28	126	4.0	23	214	.8	26	210	2.5	26	271	4.0
1,000	27	231	3.2	26	204	2.7	28	125	2.6	18	272	1.6	26	227	4.4	25	281	7.4
1,500	25	247	5.6	25	227	4.6	25	104	.5	15	297	4.6	23	240	6.8	22	288	12.2
2,000	24	259	7.6	20	242	5.5	23	281	1.2	14	290	7.8	21	255	9.4	17	295	14.5
2,500	23	258	10.6	14	256	4.4	18	282	1.1	13	282	8.6	20	263	11.1	16	285	14.6
3,000	20	259	12.3	12	264	4.1	17	263	1.5	11	273	9.6	19	276	12.7	12	284	15.2
4,000	15	255	17.4	---	----	----	17	252	5.2	---	----	----	16	275	20.1	---	----	----
5,000	10	263	19.1	---	----	----	13	255	10.0	---	----	----	13	272	22.9	---	----	----
6,000	---	----	----	---	----	----	12	259	11.1	---	----	----	10	269	24.5	---	----	----
8,000	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma, City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)			St. Louis, Mo. (181 m.)		
Surface	26	250	2.6	23	200	1.9	27	274	1.3	28	217	0.9	27	349	0.9	26	286	1.6	25	223	1.3
500	26	277	1.8	23	193	2.3	27	251	2.5	28	229	1.2	---	----	----	26	266	1.9	25	257	3.5
1,000	21	273	2.0	22	201	3.9	23	252	6.4	27	214	.9	27	342	1.1	25	263	4.4	21	242	7.1
1,500	17	281	3.6	19	239	7.2	20	258	9.7	27	212	2.2	27	305	4.6	22	268	7.6	18	248	9.8
2,000	14	327	4.2	19	245	11.4	20	265	11.5	25	232	3.3	25	299	7.9	21	276	10.8	17	260	13.0
2,500	13	321	5.1	18	250	12.7	18	270	13.9	23	236	3.6	22	285	10.0	17	269	13.9	16	266	16.4
3,000	13	313	6.6	17	254	14.5	18	267	16.3	21	236	5.3	20	290	11.8	16	274	15.5	15	265	17.8
4,000	---	----	----	15	251	17.2	15	273	18.5	20	253	7.8	18	286	14.2	14	279	18.8	14	266	22.4
5,000	---	----	----	14	253	18.9	12	280	22.4	18	262	9.9	17	284	14.5	13	287	22.0	12	267	25.3
6,000	---	----	----	11	266	18.0	11	282	24.9	17	261	12.1	15	285	15.6	12	287	27.0	---	----	----
8,000	---	----	----	---	----	----	---	----	----	12	262	14.6	12	290	17.4	---	----	----	---	----	----

Altitude (meters) m. s. l.	San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
Surface	26	98	2.1	27	273	3.1	25	289	1.4	21	221	2.4	23	222	3.5	26	254	2.0
500	26	78	1.5	26	283	3.3	25	250	1.8	21	216	4.0	---	----	----	26	248	2.8
1,000	25	147	1.4	24	276	1.3	22	258	2.9	19	220	4.2	23	237	5.6	25	259	5.7
1,500	20	222	3.7	22	315	.7	19	268	5.5	18	220	5.3	20	235	7.8	24	279	8.9
2,000	20	228	7.4	19	315	2.6	18	269	8.4	15	225	5.5	17	258	5.7	22	284	13.9
2,500	17	234	10.0	17	299	4.7	12	276	11.7	12	220	3.3	14	258	7.2	22	287	15.8
3,000	15	238	12.0	16	289	5.5	---	----	----	---	----	----	14	268	6.9	21	287	17.9
4,000	13	244	18.9	15	279	6.7	---	----	----	---	----	----	11	280	7.8	18	280	21.1
5,000	12	250	21.3	15	276	9.5	---	----	----	---	----	----	---	----	----	17	286	24.5
6,000	10	247	28.1	12	250	10.9	---	----	----	---	----	----	---	----	----	13	289	28.1
8,000	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----	---	----	----

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T., during February 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)			Columbia, Mo. (237 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	28	28	0.7	27	136	3.0	28	331	1.3	26	77	1.7	28	332	1.5	28	221	0.4	28	178	0.4
500										25	136	6.1	28	269	2.4	28	219	2.1	28	212	4.4
1,000				27	180	4.1	27	285	3.6	24	161	7.0	28	293	7.8	28	240	5.1	28	237	8.9
1,500				27	220	7.0	27	286	6.0	24	177	6.1	28	295	10.6	28	250	7.1	28	249	12.1
2,000	28	286	3.1	27	244	9.5	27	292	8.2	25	192	4.1	27	294	13.6	28	255	8.3	28	258	13.9
2,500	28	263	6.0	27	253	10.9	28	288	9.6	25	202	4.7	25	287	14.1	28	255	10.2	28	263	14.8
3,000	28	260	9.3	27	252	13.4	28	281	11.1	25	213	5.7	25	288	16.9	25	255	11.4	25	264	15.1
4,000	28	260	13.4	26	259	14.6	28	280	13.5	26	235	10.5	24	285	19.2	24	255	14.7	22	267	17.6
5,000	27	261	15.2	21	251	17.7	27	283	15.8	26	240	14.0	21	286	19.1	22	258	19.6	22	262	21.8
6,000	26	261	17.4	18	253	19.4	27	283	18.3	24	237	17.3	19	288	22.9	21	263	23.3	20	271	24.3
8,000	19	262	22.4	15	256	23.7	23	276	21.0	24	241	23.7	11	286	25.7	14	277	24.0	13	258	32.4
10,000	13	257	22.2				18	265	23.4	19	246	26.4				11	275	27.5			
12,000																					

Altitude (meters) m. s. l.	Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Medford, Oreg. (401 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	28	336	0.5	28	254	1.2	28	329	0.6	28	283	0.7	28	163	0.7	28	157	1.0
500				28	251	3.3	28	246	3.6	28	257	1.4	27	165	1.8	26	192	1.1
1,000				28	253	7.1	27	261	5.9	28	275	3.5	27	209	4.9	25	226	2.9
1,500	28	333	.6	28	256	9.0	25	274	7.2	28	285	5.3	26	223	7.8	25	237	4.7
2,000	28	219	1.9	28	261	11.2	25	270	8.9	28	286	8.2	26	236	9.7	27	248	7.4
2,500	28	227	4.7	28	265	13.4	24	273	10.5	28	284	9.8	23	250	12.1	26	263	9.0
3,000	28	243	7.0	27	261	16.2	24	276	12.9	28	286	11.2	24	249	15.0	25	268	10.2
4,000	28	256	10.2	26	260	19.3	23	269	16.5	28	280	14.9	22	249	18.1	22	276	10.8
5,000	27	261	13.3	23	268	23.2	23	272	21.0	28	277	18.7	22	251	19.3	21	284	13.3
6,000	26	261	14.8	21	268	24.7	21	278	25.9	27	276	20.7	17	249	21.2	17	306	12.6
8,000	23	260	19.8	15	272	32.6	14	277	34.9	22	268	25.6	13	243	29.7	10	334	10.1
10,000	13	268	19.0	12	278	40.4				16	262	24.6						
12,000										11	270	25.5						

Altitude (meters) m. s. l.	Miami, Fla. (12 m.)			Nantucket, Mass. (14 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (6 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	28	100	2.1	25	316	2.5	28	287	0.6	28	110	1.2	28	252	1.5	28	99	0.7	27	293	1.5
500	28	121	4.9	25	279	5.5	28	202	2.9	28	158	3.7	28	255	2.4	28	173	1.2			
1,000	28	117	4.2	25	294	7.8	28	227	6.0	28	212	3.7	28	260	2.7	27	220	4.4	27	292	1.5
1,500	28	95	2.3	25	293	9.8	27	255	7.2	28	229	5.3	27	282	3.6	26	240	7.7	27	288	7.1
2,000	28	101	1.7	23	288	14.0	26	261	10.1	28	235	8.1	27	298	4.4	23	252	8.9	27	291	9.2
2,500	28	134	1.8	22	284	15.2	25	267	12.4	27	243	10.4	27	295	6.2	25	250	11.5	26	293	11.4
3,000	28	205	2.0	21	283	17.4	25	268	16.8	27	243	12.5	27	302	8.1	25	257	13.2	23	291	11.2
4,000	27	238	4.5	20	287	19.6	23	266	20.3	23	250	18.0	25	309	10.5	24	256	14.4	15	292	13.5
5,000	28	252	7.3	17	287	19.7	20	260	24.2	23	250	23.7	24	307	11.5	23	254	16.3	16	286	16.8
6,000	27	254	8.8	14	277	22.3	17	262	27.4	20	250	27.0	23	313	13.6	21	257	18.7	16	285	19.3
8,000	27	270	14.7				12	263	30.4	14	253	33.1	20	304	16.0	16	254	25.8	12	294	20.1
10,000	25	280	16.0										19	305	21.8	10	255	30.8			
12,000	21	279	22.9										16	303	24.2						
14,000	13	275	19.2										10	293	20.0						
16,000																					

Altitude (meters) m. s. l.	San Antonio, Tex. (242 m.)			San Juan, P. R. (28 m.)			St. Cloud, Minn. (318 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (221 m.)			Spokane, Wash. (726 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	28	78	2.3	28	85	6.8	28	293	0.9	28	294	1.1	27	317	0.9	26	202	2.7
500	28	99	3.7	27	79	9.5	27	260	2.0	28	329	3.9	27	252	2.5			
1,000	28	150	3.9	27	81	9.5	27	273	4.2	28	334	3.3	25	243	6.8	26	223	5.1
1,500	28	202	5.9	26	82	8.6	27	272	6.3	28	335	3.4	22	255	7.8	24	240	7.6
2,000	28	231	7.7	26	78	8.1	28	264	8.6	28	322	4.9	22	260	9.6	22	244	7.3
2,500	28	238	9.9	26	80	7.7	28	270	10.1	28	313	6.6	21	266	12.3	21	255	6.8
3,000	28	245	11.9	26	77	7.0	28	271	11.8	28	311	8.6	21	266	14.9	21	269	8.0
4,000	28	248	15.7	25	72	6.4	28	268	15.8	27	296	10.8	18	272	17.6	20	274	11.6
5,000	27	248	19.3	25	60	6.8	28	267	17.7	27	293	12.4	14	277	19.0	20	284	15.7
6,000	25	245	23.8	24	49	6.9	21	258	20.1	27	299	14.8	11	276	22.0	13	316	12.6
8,000	16	251	32.7	23	359	7.8	16	268	20.4	23	291	16.6						
10,000				23	307	15.9	12	264	23.4	18	289	20.0						
12,000				23	306	21.3				13	291	18.0						
14,000				19	309	14.1				11	272	17.1						
16,000				12	350	8.4												

Altitude (meters) m. s. l.	Tatoosh Island, Wash. (33 m.)		
	Observations	Direction	Speed
Surface	24	131	2.0
500	23	201	3.1
1,000	22	227	4.7
1,500	21	232	4.5
2,000	21	242	5.5
2,500	21	255	6.2
3,000	20	247	7.2
4,000	20	263	9.0
5,000	20	282	13.5
6,000	15	281	4.2
8,000	15	282	9.8
10,000	12	297	14.7
12,000	10	296	18.1

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following table 3 in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR FEBRUARY 1949

ELMER R. NELSON

River stages during February in general averaged above normal along the Atlantic slope from southern New York through the east Gulf of Mexico drainage. Stages were also above normal over most of the Mississippi system, considerably below normal in the Sacramento Basin in California, and slightly below in portions of the west Gulf of Mexico drainage. The greatest positive departure was at Cairo, Ill., where the Ohio River averaged 18.7 feet above normal. The greatest negative departure was at Sacramento, Calif., where the Sacramento River averaged 9.6 feet below normal. The most damaging floods during the month were those due to ice action in the lower Missouri Basin. Incomplete returns indicate losses will run into several million dollars. One of the most notable of the ice break-ups and gorges occurred on the Nemaha River at Falls City, Nebr., where the previous maximum stage of record was exceeded. Considerable damage also resulted from local flooding in the Columbia Basin.

Most of the streams along the Atlantic slope remained free of ice throughout February except those in northern New England. By the end of the month most of the ice had moved out of the Merrimack River Basin in New Hampshire and Massachusetts. In the Mississippi system, there was an unusually heavy accumulation in the tributaries of the Missouri River. Ice was about 3 feet thick in the upper Missouri and about 2 feet in the Yellowstone. The ice was heavy in the upper Mississippi Basin above the mouth of the Des Moines River, ranging in thickness from 29.5 inches at Minneapolis, Minn., to 8.5 inches at Davenport, Iowa, on the 28th. It was heavy in the Des Moines Basin but was starting to break and gorge as the month closed. Ice gorges occurred in the Columbia Basin in portions of Montana, eastern Washington and eastern Oregon and caused some local flooding. All streams in the Snake Basin were low but full of ice.

Precipitation during February was quite spotty and was below normal over a wide area extending southwestward from the upper Great Lakes region through the southern half of the Western States. It was also mostly below normal along the Middle Atlantic Coastal States and in southern Florida. It was well above normal in the Columbia Basin except in a few areas, which is a striking contrast to the light precipitation of the previous month. The total snowfall during February and the

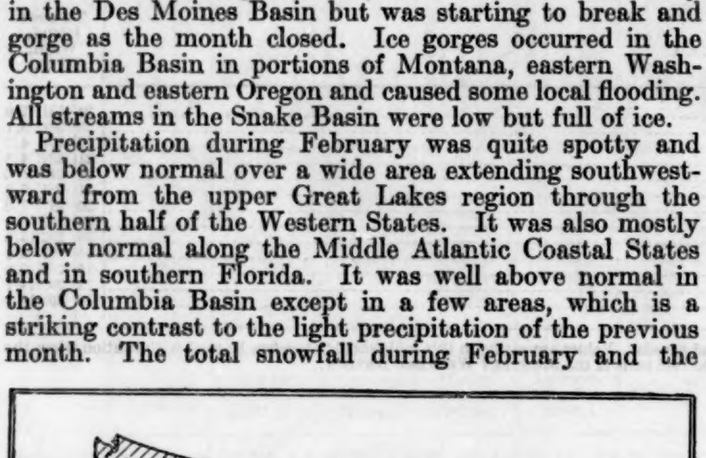


FIGURE 1.—Percentage of normal precipitation by states, Winter (December–February) 1948–49.

depth of snow on the ground at the close of the month is shown in chart VII in the illustration section of the Review. Precipitation during the winter of 1948–1949 (December–February) was above normal over the country except in California, Nevada, North Carolina, and Florida and is shown in percent of normal in figure 1.

St. Lawrence Drainage.—Slight flooding occurred in the Lake Michigan drainage in the Shiawassee and Red Cedar Rivers due to the moderate rain (0.85 inch) on the 15th–17th. No damage resulted. Much of the snow and ice cover in the Grand River Valley melted from the mild temperatures and moderately heavy rains on the 12th and 13th and caused the streams to rise rapidly to near bank-full stage. No flooding occurred except in the low suburban areas of Grand Rapids, Mich.

A spring freshet occurred in the Lake Erie drainage in the St. Marys, St. Joseph, and Maumee Rivers during the latter half of the second decade of February. This freshet was augmented by release of considerable amounts of ground water due to thawing weather. It was not very severe and the damage resulting was minor as the lowland areas are flooded every year.

Atlantic slope drainage.—Slight flooding occurred on the Cape Fear, Neuse, and Roanoke Rivers in eastern North Carolina due to the moderate rains that occurred at various times during the month. The frequency and amount of rainfall kept the Roanoke at or slightly above flood stage at Williamston throughout most of the month.

Moderate to heavy rains on the 9th–10th caused light overflows in the Edisto River in South Carolina. Heavy rains on the 20th resulted in some flooding on the Pee Dee and Saluda Rivers. The rainfall averaged about 2 inches during the 24-hour period over the Saluda and Broad Rivers.

Heavy rainfall (2 inches) on the 9th–10th caused light flooding in the Savannah and Ogeechee Rivers. No damage of consequence resulted.

The most important rises in the Altamaha River system in Georgia occurred as a result of rainy conditions from the 4th to 10th. Amounts of 1 to 2 inches were fairly common and widespread during the 24-hour periods ending on the mornings of the 5th, 7th, 9th, and 10th. Flood stages were reached only in the lower portions of the Ocmulgee, Oconee, and in the upper Altamaha. Flood stages were not greatly exceeded and no appreciable losses were sustained.

East Gulf of Mexico.—Moderate flooding occurred in the lower portion of the Apalachicola River in Georgia due to the heavy rain over the basin on the 5th, 7th, 9th, and 10th. Moderate to heavy rains occurred again on the 16th, 19th, and 27th.

The lower reaches of the Warrior and Tombigbee Rivers in Alabama remained above flood stage throughout most of the month due to the high initial stages resulting from the severe flooding in January and the occasional heavy rains during February.

The Pearl River remained above bank-full stage throughout the month at and below Jackson, Miss. The stages during February were not as high as those during January except at Pearl River, La. The Chickasawhay at Enterprise, Miss., was briefly above flood stage and the Pascagoula River at Merrill, Miss., was above bank-full stage for about 1 week. The flood condition on the intermediate and upper reaches of the Pearl River was maintained by the numerous showers which culminated in generally excessive rain on the 15th. This storm originated in the Gulf of Mexico and moved northeastward across southern Mississippi and central Alabama, producing excessive rainfall over the lower part of the head-

waters of the Pearl River and throughout the intermediate reaches, as well as over the middle reaches of the Leaf and Chickasawhay and the headwaters of the Pascagoula River. This excessive rainfall added to the existing flood. The prolonged flooding of the Pearl River in the Jackson area delayed oil drilling operations in the flood plain in that area but added little, if any, to the hazards that already existed due to the January flood.

Upper Mississippi Basin.—Precipitation has been above normal throughout the winter in the upper Mississippi Basin. During the winter season, precipitation averaged 180 percent of normal in the Mississippi Basin above La Crosse, Wis., 185 percent in the Minnesota River Basin, and 137 percent in the Wisconsin River Basin. A summary of the precipitation during January and February is given in table 1.

TABLE 1.—*Precipitation data for Upper Mississippi Basin, January and February 1949*

Basin or area	Observed (inches)	Normal (inches)	Excess (inches)	Percent of normal
Mississippi River (above La Crosse, Wis.)	2.24	1.50	0.74	149
Mississippi River (La Crosse to Keokuk, Iowa)	3.49	2.81	.68	124
Mississippi River (Keokuk to St. Louis, Mo.)	6.96	4.01	2.95	174
Des Moines River	3.11	2.08	1.03	149
Entire Mississippi Basin (above Missouri River)	3.95	2.60	1.35	152

The following is a summary of the water equivalent of the snow cover in the Upper Mississippi Basin on the 28th of February:

State and station	*Water equivalent (inches)*
Wisconsin:	
Berlin	1.6
LaCrosse	0.9
Lady Smith	3.5
Madison	.8
Plattsville	2.5
Minnesota:	
Bemidji	2.8
Madison	2.4
St. Cloud	2.7
St. Paul	.7
Iowa:	
Mason City	.8

Light to moderate flooding occurred in the southern portion of the Upper Mississippi Basin in southern Iowa, western Illinois, and eastern Missouri during the last half of February. Flooding along the Skunk River at Augusta, Iowa, and the Mississippi at Hannibal, Mo., was due partly to ice action.

The Raccoon River at Van Meter, Iowa, and the Des Moines River at Tracy and Eddyville, Iowa, exceeded flood stage during the latter part of the month. The flooding was due principally to run-off from snow-melt caused by the mild weather during the last half of the month and the accompanying ice action. Colder weather at the close of the month caused a temporary slackening of run-off with the Raccoon and the Des Moines River at Tracy, Iowa, falling below bank-full stage. The ice was still holding at the end of February.

Flooding along the Illinois River was caused by moderately heavy rain (0.8 inch) on the 12th–13th in the upper reaches of the basin. Crests in the lower reaches were delayed considerably and were somewhat higher as unseasonably mild weather and occasional rains during that period caused considerable snow-melt and gorging of ice.

Missouri Basin.—Precipitation during February was considerably below normal in the Missouri Basin. It ranged from 3 percent of normal in the Platte Basin to 96 percent of normal in the Lower Missouri and averaged 70 percent of normal. During January it ranged from 137 percent of normal in the upper Missouri to 316 percent of normal in the lower reaches of the Missouri and averaged 268 percent of normal over the entire basin. A summary of the average precipitation conditions during January and February is given in table 2.

TABLE 2.—*Precipitation data for Missouri River Basin, January and February 1949*

Basin or area	Observed (inches)	Normal (inches)	Excess (inches)	Percent of normal
Upper Missouri (Plains Area above Bismarck, N. Dak.)	1.15	0.98	0.17	115
Middle Missouri and Tributaries (Bismarck to Sioux City, Iowa)	1.38	1.12	.26	123
Lower Missouri (below Sioux City)	6.50	3.15	3.35	206
Platte Basin	1.59	1.16	.43	137
Kansas Basin	2.69	1.45	1.24	186
Entire Missouri Basin	2.66	1.57	1.09	169

The only appreciable snow cover remaining in the Missouri Basin by the end of the month was in North Dakota, northern South Dakota and portions of Montana, Wyoming, and northeastern Nebraska. The only snow cover remaining in Missouri, Kansas, and southern Nebraska was on the steep north slopes and in the heavily timbered areas.

The floods in the Missouri Basin during February were due principally to moderate run-off from snow-melt accompanying the break up of heavy ice.

An extensive, severe ice gorge formed during January on the Missouri River just above Leavenworth, Kans. Continuous heavy floating ice from upstream caused the jam to build northward, until by the end of the month the Missouri was almost a solid mass of jagged ice above Leavenworth. Backwater flooding extended progressively northward and was general throughout that area. Some large floes stood on end and were visible from behind levees. Across from Atchison, Kans., ice acting as a glacier allowed water to inundate the community of Winthrop, Mo. which was evacuated. Three resort lake areas across from Atchison were also evacuated as river water caused the lakes to overflow, surrounding many cottages.

As the Missouri River ice gorge extended, a series of thaws caused ice break ups and gorges on rivers and tributaries in southeast Nebraska, southern Iowa, and northern Missouri. One of the most notable was on the Nemaha River which reached a new all-time high of 26.9 feet at Falls City, Nebr., exceeding the previous record of 25.6 feet of June 13, 1947. Another gorge took out at least one bridge on the Nodaway River near Burlington Junction, Mo. As thaws recurred and tributary gorges broke, these swollen streams added to the burden of the already ice-plagued Missouri. For the second consecutive month the Missouri River at Atchison, Kans., crested 1 foot under the all-time high mark of 26.4 feet established in 1881. Two temporary ice breaks occurred at St. Joseph, Mo.

Moderate to severe flooding occurred in the upper reaches of the Republican, Solomon, and Blue Rivers in Kansas and Nebraska due to run-off from snow-melt and backwater from ice gorges that formed as the heavy ice in the channels broke up. The most extensive gorges were formed in the vicinity of Guide Rock, Nebr., and Scandia, Kans., on the Republican and at Beloit, Kans., on the Solomon. There was also a considerable blocking effect from ice jams at Cambridge, Nebr., and below Con-

cordia on the Republican as well as along the lower reaches of the Big Blue, but in these areas the overflow was quite restricted.

The Ohio Basin.—The Ohio River at the beginning of the month was receding below flood stage from a minor flood (1–3 feet above flood stage) in the reach from Point Pleasant, W. Va., to above Evansville, Ind. In the reach above Point Pleasant a steady recession was already in progress, while at Evansville and below rising stages prevailed until the 4th with crests up to 18 feet above flood stage at dam 50. From the 5th to the 13th a general recession prevailed throughout the Ohio River reaching pool conditions above Point Pleasant on the 10th.

Heavy general rain occurred over the basin from the 13th–15th, averaging 1.5 inches in the upper portion and nearly 4 inches in the lower reaches. The rain averaged about 2 inches in the upper White and Wabash rivers and from 3 to 4 inches in the lower reaches. Rapid rises occurred on the Ohio and tributaries. The lower White and Wabash Rivers crested 5 to 9 feet above flood stage, the Green, 3 to 15 feet above flood stage and the Scioto slightly above bank-full stage. The Licking, lower Kentucky, Little Miami, and Hocking Rivers crested slightly below flood stage. The Ohio, in the reach from dam No. 14 to dam No. 25 crested from 23 to 30 feet on the 18th; exceeded 40 feet in the lower portion of the reach from Point Pleasant, W. Va., to dam No. 30; and from 45 to 50 feet in the reach from Portsmouth, Ohio, to dam No. 45 by the 21st. Several stations in the lower reach of the Ohio had not dropped below flood stage before these general rains began and as a result some of these stations remained above flood stage throughout February.

Several periods of light to moderate rainfall occurred during the latter part of the month causing only moderate or slight rises on most tributaries and slowing down the recession on the Ohio. At the close of the month the Ohio was falling steadily from dam No. 12 to Cairo, Ill., with the upper reaches approaching pool conditions and the lower reaches below Evansville, Ind., approaching bank-full stage.

White Basin.—The flooding in the White Basin during February was a continuation of the floods that began during the last decade in January. These floods were due to torrential rains accompanying the Low moving northeastward from Texas across Arkansas. Several stations in Arkansas reported amounts between 8 to 10 inches during the week ending January 27. It was the wettest January on record except for 1937.

The stages on the White and Black were high but not record breaking except at Georgetown, Ark., where the previous maximum of record (31.4 feet) on May 18, 1943, was exceeded by 1.4 feet on January 31. The flood above Batesville, Ark. was not as severe as on the lower White. It, however, was severe in the lowlands in the reach between Batesville and Newport. State highway No. 14 between those cities was under water for several days. Central Avenue in Batesville was flooded by the Polk Bayou. The Missouri Pacific, White River Division Tracks at Creswell, Ark., four miles south of Calico Rock, were blocked by a landslide from rain-soaked earth that slid over the tracks. Walnut Ridge and Jonesboro, Ark. reported local flash floods. The levees at Jacksonport, Ark., were topped causing flooding in that section. Severe damage resulted to highways and bridges.

Arkansas Basin.—Widespread minor flooding occurred in the Arkansas Basin in Kansas and Oklahoma during February. The flooding on the Ninnescah, Cottonwood, Little Arkansas, and Neosho Rivers and Cow Creek was due to rapid snow-melt. Ice jams occurred in the vicinity of Peck, Kans., on the Ninnescah and above Hutchison, Kans., on the Arkansas River and Cow Creek, which helped to produce the floods in these streams. Only a small amount of precipitation or snow-melt was necessary to cause these floods as the streams remained from one-half to three-fourths bank-full throughout the month due to the heavy ground-flow from the saturated ground.

One- to three-inch rains on the 13th and 14th in east-central Oklahoma resulted in minor flooding along the Deep Fork Creek near Dewar, Okla. Heavy run-off occurred as the ground was thoroughly saturated from the heavy precipitation during January. Damage was negligible.

Precipitation during the month was not excessive as during January but it was sufficiently high to cause the antecedent soil index to continue much above normal.

Red Basin.—The flooding in the Red Basin during the early part of the month was due to the unusually heavy rains and floods during the latter part of January. In western Arkansas the Mena area was hard-hit with several business establishments reporting 6 to 8 inches of water in their buildings. For a while it appeared as if the new earthen dam at the city's reservoir might not hold but fortunately it did. Traffic was halted on Highway 8 when Carter Creek flooded a low bridge. At DeQueen, Ark., local creeks flooded highways washing away a stack of lumber on Highway 27. At Russellville, Ark., a local flood forced 100 students and their families from Arkansas Tech to evacuate their homes. Six persons lost their lives in these floods.

Scattered heavy rains over the headwaters of the Sulphur River on the 12th resulted in some flooding at Naples, Tex. Additional heavy rain (2.5 inches) over the basin on the 23d–24th produced general flooding along the entire river, a distance of 188 miles.

Lower Mississippi Basin.—The St. Francis River continued in flood from the latter part of January into the first week of March. The stage at Fisk, Mo., remained nearly stationary for several days at about 4 feet above flood stage from the latter part of January through the first week of February due to the constant discharge from the reservoir above Wappapello Dam which had been filled by the heavy rains in January. Locally light to moderate rains occurred on the 4th which caused a slight rise at St. Francis, Ark. Moderate to heavy rains occurred on the 14th and 15th, averaging about 3 inches in the upper portion, 5 inches in the middle, and 1.8 inches in the lower reaches. The stage at Fisk, Mo., rose only 0.5 foot due to the regulation of the Wappapello Dam.

Rainfall averaged near or slightly below normal in the Yazoo-Tallahatchie Basin during the month. The rivers remained nearly stationary or fell slowly throughout February except from the 7th–10th, as the rains were well distributed and not very heavy. The Yazoo was still about 6 feet above flood stage at the end of the month but had receded to a stage of 2.3 feet below bank-full stage at Greenwood, Miss. The Tallahatchie at Swan Lake, Miss., was 0.4 foot above flood stage and was falling very slowly.

The lower Mississippi continued above flood stage at New Madrid and Caruthersville, Mo., from early in January through the first week in March. It receded steadily through the first half of February and rose again during the last half cresting near the end of the month slightly lower than the first. The second rise was due to moderately heavy rains over the middle Mississippi and

Ohio Basins from the 13th to the 15th. Moderate rains (1.5 inches) were reported over the Tennessee and Cumberland Basins on the 19th and 20th.

The main damage resulting was to corn and cotton crops which had not been harvested due to wet weather, and flooding of pasture lands.

West Gulf of Mexico Drainage.—Heavy and widespread rains occurred over the upper Trinity Basin on the 23d to the 25th and caused rapid rises to above bank-full stage. It rose 15 feet at Dallas, Tex., from a stage of 17 feet to 4 feet above flood stage, during the 24-hour period ending at 7 a. m. on the 24th. The stage was set for heavy run-off prior to this storm as the soil was saturated from the rain on the 20th and 21st. No damage of consequence occurred as most vegetation is dormant during February.

The upper Sabine in Texas was receding in the beginning of the month from the minor flood of January. The crest flattened out in moving downstream and flood stage was not reached at Logansport, La., or Milam, Tex., although it exceeded flood stage slightly below at Bon Wier, Tex., due to the scattered rains in the middle basin on the 9th and 10th. Most of the damage occurred in the Gladewater, Tex., area in the loss of oil production.

A minor flood occurred in the lower Trinity at Liberty, Tex., from the 27th to March 2. This flood was caused by excessive rains, ranging from 1 to 4 inches from the 23d to the 26th. The rain averaged 2.18 inches during the 4-day period in the reach below Long Lake, Tex. No damage occurred from this overflow.

Heavy rains during the early morning hours of the 25th in the Del Rio-Eagle Pass, Tex., area caused the Rio Grande to exceed flood stage in that area. The rainfall averaged 3 to 5 inches and occurred in period of 2 to 4 hours. Some inconvenience was experienced by travelers due to the temporary closing of highways; otherwise no damage occurred.

Columbia Basin.—Generally minor flooding occurred on the main stem of the Willamette River and along the lower reaches of the principal tributaries from the 16th to the 26th and in a few of the more minor tributaries from the 10th to the 12th. Record heights were reached on the headwaters of the Tualatin and the Yamhill during the period of record.

The flooding occurred in connection with the breakup of an exceptionally long, cold winter. Precipitation was light during January with numerous light snows in the valley and heavier amounts at higher elevations. The soil was frozen to depths ranging from a few inches to as much as 7 inches.

The first break in the weather occurred on the 10th but it was only temporary. Moderate to moderately heavy precipitation occurred on that date for a period of about 20 hours. Severe flooding and considerable damage occurred along low lying areas of a few small streams in western Oregon.

The main break in the weather began on the 18th. The rains over the Willamette basin were moderate to heavy except light to moderate in the tributaries of the Upper Willamette. Light to moderate rains occurred for 2 to 3 days in some areas. In other areas the storm was comparatively short and for that reason the flooding along the main stem of the Willamette and most of its tributaries was minor except on the Santiam and Yamhill. No damage except erosion occurred on the main stem of the Willamette and the principal tributaries.

Localized destructive flooding occurred on Johnston Creek (east of Portland) and on the lower reach of the Tualatin River. Intense local flooding occurred in northeastern Oregon and southeastern Washington. This flooding was due to the warm light to moderate rains on the 21st and the run-off from snow melt caused by the warm weather that followed during the remainder of the month. The precipitation at Portland, Oreg., during February (11.43 inches) was the greatest since 1881.

Chehalis and Puget Sound Drainage.—Moderate flooding occurred on two occasions along the Chehalis River in Washington and its upper tributaries, the Newaukum and Skookumchuck. The first flood on the 17th and 18th was due to effective rainfall averaging 2.92 inches during a period of 36 hours. There was a moderate snow cover over the basin prior to this storm, especially at elevations above 1,000 feet, and a contributing cause of the flood was the run-off from the melting snow. The second flood from the 22d–24th was due to effective rainfall averaging 1.92 inches during a period of 48 hours. Moderate damage resulted from the flooding. The flooding along the Snohomish and Satsop Rivers was of a minor nature and no losses were reported.

FLOOD STAGE REPORT FOR FEBRUARY 1949

[All dates in February unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE					
Lake Michigan					
Red Cedar:	*Feet*			*Feet*	
Williamston, Mich	7	14	16	8.8	15
East Lansing, Mich	8	14	17	9.4	16
Lake Huron					
Shiawassee: Owosso, Mich	7	15	16	7.6	15
Lake Erie					
St. Marys: Decatur, Ind	13	15	18	16.6	16
St. Joseph: Montpelier, Ohio	10	15	20	13.2	16
Maumee:					
Fort Wayne, Ind	15	15	20	18.2	17
Defiance, Ohio	10	16	18	11.3	17
ATLANTIC SLOPE DRAINAGE					
Roanoke: Williamston, N. C	10	5	[2]	10.9	16, 17
Neuse: Smithfield, N. C	13	13	13	13.1	13
Cape Fear: Elizabethtown, N. C	20	22	23	21.8	22
Pee Dee: Pee Dee, S. C	19	22	27	20.1	24
Saluda:					
Pelzer, S. C	6	19	22	7.5	20
Chappels, S. C	13	9	10	14.6	9
Edisto:					
Orangeburg, S. C	8	10	15	9.3	11
Givhans Ferry, S. C	10	13	Mar. 2	11.5	18
Savannah: Butler Creek, Ga	21	10	12	22.8	11
Ogeechee:					
Midville, Ga	6	14	15	6.3	14
Dover, Ga	7	13	----------	7.9	16
Ocmulgee: Abbeville, Ga	11	13	[2]	12.8	16
Oconee:					
Milledgeville, Ga	20	10	11	21.4	10
Mt. Vernon, Ga	16	14	19	17.4	16
Altamaha: Charlotte, Ga	12	7	[2]	17.7	20, 21
EAST GULF OF MEXICO DRAINAGE					
Apalachicola: Blountstown, Fla	15	Dec. 1	[2]	23.6 20.6 20.9	Dec. 6 Jan. 11 14
Coosa: Gadsden, Ala	20	19	22	20.6	21
Cahaba: Centreville, Ala	23	16	17	23.5	17
Alabama: Millers Ferry, Ala	40	16	27	46.1	21
Black Warrior:					
Tuscaloosa Lock and Dam, Ala.	47	17	20	49.0	17
Lock No. 7, Eutaw, Ala	35	6 17	15 27	40.5 46.2	8 23
Tombigbee:					
Gainesville, Ala	36	Jan. 7	24	53.7	Jan. 11
Lock No. 4, Demopolis, Ala	39	Jan. 9	[2]	65.2	Jan. 14
Lock No. 3	33	Nov. 2	[2]	61.5	Jan. 16
Lock No. 1	31	Jan. 6	[2]	43.8	20
Bogue Chitto: Franklinton, La	11	17	19	11.6	19
Chickasawhay: Enterprise, Miss	20	18	19	20.5	18
Pascagoula: Merrill, Miss	22	19	26	23.7	22
Pearl:					
Jackson, Miss	18	Nov. 20	[2]	32.9 33.1 30.5 29.5	Dec. 6. Jan. 12. Jan. 26. 1.
Monticello, Miss	15	Jan. 5	[2]	20.8 22.9 20.8	Jan. 7. Jan. 20. 17.

See footnotes at end of table.

FLOOD STAGE REPORT FOR FEBRUARY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
EAST GULF OF MEXICO DRAINAGE—continued	*Feet*			*Feet*	
Pearl—Continued					
Columbia, Miss.	17	Jan. 7	(2)	19.7 22.4 21.0	Jan. 11. Jan. 23. 19.
Pearl River, La.	12	Nov. 24	(2)	16.7 15.0 15.8 16.1	Nov. 30. Jan. 15. Jan. 27. 22.
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Pecatonica: Freeport, Ill.	10	25	(2)	12.2	Mar. 1.
Rock: Moline, Ill.	10	19			
Iowa: Wapello, Iowa	10	27	27	10.0	27.
Skunk: Augusta, Iowa	15	25	(2)	16.3	26.
Raccoon: Van Meter, Iowa	13	24	25	13.7	24.
Des Moines:					
Tracy, Iowa	14	24	27	17.3	25.
Eddyville, Iowa	15	24	(2)	19.6	27.
Illinois:					
Morris, Ill.	13	14	14	13.4	14.
Peru, Ill.	17	13 19 22 25	15 20 22 26	19.1 18.0 17.1 17.6	14. 19. 22. 25.
Havana, Ill.	14	18	(2)	16.6	24-27.
Beardstown, Ill.	14	5 18	9 (2)	14.4 18.5	7. 27.
Meramec:					
Sullivan, Mo.	11	15	17	18.6	15.
Pacific, Mo.	11	16	18	19.0	18.
Valley Park, Mo.	14	16	19	20.9	17.
Mississippi:					
Hannibal, Mo.	13	21	21	13.3	21.
Louisiana, Mo.	12	20 26	21 (2)	12.1 12.8	21. 27.
Missouri Basin					
Nemaha: Falls City, Nebr.	20	12 17 23	13 20 25	21.6 26.9 25.7	12. 19. 24.
Tarkio: Fairfax, Mo.	17	24	24	20.4	24.
Nodaway: Burlington Junction, Mo.	16	24	27	18.3	24.
Platte: Agency, Mo.	20	24	28	24.4	27.
Solomon: Beloit, Kans.	18	12 19 24	14 21 27	21.0 21.5 26.9	13. 20. 26.
Little Blue:					
Endicott, Nebr.	9	24	Mar. 2	12.5	25, 27.
Hanover, Kans.	14	26	26	19.0	26.
Big Blue: Randolph, Kans.	22	19 25	20 Mar. 1	22.8 23.0 23.4	19. 25. 28.
Republican:					
Benkelman, Nebr.	5	22	24	5.6	23.
Cambridge, Nebr.	5	13	Mar. 4	5.4 6.8 8.5	14. 19. 23-24.
Orleans, Nebr.	9	24	26	10.6	25.
Guide Rock, Nebr.	10	24	Mar. 6	12.7	24.
Scandia, Kans.	10	25	Mar. 5	14.5	5.
Stranger: Tonganoxie, Kans.	23	24	26	24.4	26.
Grand:					
Pattonsburg, Mo.	20	24	26	25.8	25.
Gallatin, Mo.	20	25	25	20.3	25.
Chillicothe, Mo.	18	19 24	20 (2)	19.8 27.9	19. 25.
Sumner, Mo.	25	19 24	22 (2)	28.0 31.2	20. 27.
Brunswick, Mo.	12	25	(2)	13.7	28.
Chariton: Novinger, Mo.	19	19 24	19 (2)	19.0 23.6	19. 25.
Lamine: Clifton City, Mo.	15	Jan. 15 Jan. 23 14	Jan. 17 Jan. 25 15	20.3 23.0 15.4	Jan. 16. Jan. 24. 14.
Blackwater: Blue Lick, Mo.	25	Jan. 16 13	Jan. 19 19	27.8 29.7	Jan. 17. 16.
Marais des Cygnes:					
La Cygne, Kans.	25	13	14	26.5	14.
Trading Post, Kans.	24	14	15	24.3	14.
Osage:					
Osceola, Mo.	20	17	19	22.6	18.
Warsaw, Mo.	31	17	19	31.6	17, 18.
Missouri:					
Nebraska City, Nebr.	15	Jan. 23 27	Jan. 24 (2)	16.2 15.1	Jan. 24. 28.
Nodaway, Mo.	17	Jan. 24 6	Jan. 28	20.1 21.0	Jan. 24. 20, 25, 26.
St. Joseph, Mo.	17	20 26	21 (2)	17.2 17.7	21. 27.
Atchison, Kans.	20	Jan. 15 3	1 (2)	20.0 25.4	1. 28.
Ohio Basin					
Scioto:					
La Rue, Ohio	11	16	16	12.2	16.
Prospect, Ohio	10	17	17	10.2	17.
Circleville, Ohio	14	16	17	15.7	17.
Piketon, Ohio	15	16	18	20.0	16.

See footnotes at end of table.

FLOOD STAGE REPORT FOR FEBRUARY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
Ohio Basin—Continued	*Feet*			*Feet*	
Barren: Bowling Green, Ky.	28	15 21	18 21	31.3 28.2	17. 21.
Green:					
Munfordville, Ky.	28	15	21	43.0	17.
Lock No. 6, Brownsville, Ky.	28	14	23	43.7	18.
Lock No. 4, Woodbury, Ky.	33	14	26	46.3	19.
Lock No. 2, Rumsey, Ky.	34	1 15	12 (2)	41.2 43.1	2. 25.
West Fork:					
Anderson, Ind.	10	16	16	12.1	16.
Spencer, Ind.				18.4	17.
Elliston, Ind.	18	Jan. 18 16	2 21	26.6 24.8	Jan. 23. 18.
Newberry, Ind.				18.9	19.
Edwardsport, Ind.	12	Dec. 30 15	7 (2)	17.8 24.1 20.9	Jan. 2. Jan. 25. 19-20.
East Fork:					
Columbus, Ind.				11.3	16.
Seymour, Ind.	14	16	18	17.0	16.
Bedford, Ind.				27.3 24.4	1. 19.
Williams, Ind.	10	Jan. 23 19	3 21	18.7 12.2	Jan. 28. 20.
Shoals, Ind.	25	Jan. 25	3	30.5	Jan. 29.
White:					
Petersburg, Ind.	16	Jan. 4 8	3 26	25.5 22.6	Jan. 28. 22.
Hazleton, Ind.	16	Jan. 4		27.9 23.6	Jan. 27. 22-23.
Wabash:					
Bluffton, Ind.	10	15	18	10.4	17.
Wabash, Ind.		15	18	18.3	15.
La Fayette, Ind.	11	Jan. 18 15	1 27	21.7 20.4	Jan. 20-21. 17.
Covington, Ind.	16	Jan. 19 16	2 27	25.0 23.8	Jan. 22. 21.
Terre Haute, Ind.	14	Jan. 5 16	6 20	20.6 19.8	Jan. 23. 20.
Hutsonville, Ill.				23.2	21.
Riverton, Ind.				20.5	22.
Vincennes, Ind.	16	Jan. 7 17	8	23.9 21.0	27, 28. 23-24.
Mount Carmel, Ill.	17	Jan. 5 17	10 (2)	25.9 23.2	Jan. 28. 23.
New Harmony, Ind.	15	Jan. 7 19	(2)	22.0 18.6	Jan. 29. 25.
Cumberland: Lock F, Eddyville, Ky.	50	21	27	53.1	24.
Ohio:					
Tell City, Ind.	38	Jan. 27	6	43.7	Jan. 31.
Dam No. 46, Owensboro, Ky.	41	Jan. 29	5	42.6	1.
Dam No. 47, Newburgh, Ind.	38	Jan. 26 17	9 (2)	45.2 42.8	1. 22.
Evansville, Ind.	42	Jan. 30	6	43.1	2.
Dam No. 48, near Henderson, Ky.	38	Jan. 27 18	11 (2)	45.9 42.2	2. 23.
Mount Vernon, Ind.	35	Jan. 26 18	12 (2)	45.0 40.2	3. 25.
Dam No. 49, Uniontown, Ky.	37	Jan. 26 19	13 (2)	48.3 42.6	4. 25.
Shawneetown, Ill.	33	Jan. 7	(2)	38.8 49.2 43.1	Jan. 14. 4. 26.
Dam No. 50, Fords Ferry, Ky.	34	Jan. 7	(2)	41.7 52.2 46.0	Jan. 15. 4. 26.
Dam No. 51, Golconda, Ill.	40	21	Mar. 2	43.5	25.
Paducah, Ky.	39	20	Mar. 3	42.8	25.
Dam No. 52, Brookport, Ill.	37	Jan. 22	Mar. 6	48.0 48.0 44.8	Jan. 30. 3. 25.
Dam No. 53, near Mound City, Ill.	42	Jan. 7	Mar. 7	47.7 52.6 50.5	Jan. 15. Jan. 30. 25.
Cairo, Ill.	40	Jan. 9	Mar. 8	44.4 50.5 49.2	Jan. 16. Jan. 31. 26.
White Basin					
Buffalo: Gilbert, Ark.	30	Jan. 24	Jan. 24	41.6	Jan. 24.
Black:					
Poplar Bluff, Mo.	16	Jan. 25	Jan. 26	18.7	Jan. 25.
Black Rock, Ark.	14	Jan. 18	(2)	28.5	Jan. 25
White:					
Cotter, Ark.	21	Jan. 28 16	Jan. 29 18	23.8 22.2	Jan. 28. 18.
Calico Rock, Ark.	19	Jan. 25 15	Jan. 30 19	37.7 24.0	Jan. 25. 16.
Batesville, Ark.	23	Jan. 25 15	1 20	37.6 29.8	25. 16.
Newport, Ark.	26	Jan. 25 16	8 25	34.0 30.9	Jan. 28. 19.
Augusta, Ark.	32	Jan. 25	Mar. 4	39.3	Jan. 30.
Georgetown, Ark.	21	Jan. 22	Mar. 8	32.8 27.4	Jan 31. 22.
Des Arc, Ark.	24	Jan. 25	Mar. 13	37.4 30.6	2. 24.

FLOOD STAGE REPORT FOR FEBRUARY 1949—Continued

River and station	Flood stage	Above flood stages—dates From—	Above flood stages—dates To—	Crest [1] Stage	Crest [1] Date
MISSISSIPPI SYSTEM—continued					
White Basin—Continued	Feet			Feet	
White—Continued					
Clarendon, Ark	26	Jan. 22	(2)	35.3	6.
				31.5	27.
St. Charles, Ark	25	Jan. 11	(2)	33.9	10.
Arkansas Basin					
Cow Creek: Lyons, Kans	15	10		18.5	11.
		16		18.5	19.
Little Arkansas: Sedgwick, Kans	18	12	14	20.3	12.
		18	19	19.3	18.
		27	27	18.3	27.
Ninnescah: Peck, Kans	17	12	12	18.1	12.
Verdigris:					
Independence, Kans	30	13	14	35.0	14.
Claremore, Okla	38	16	17	39.0	17.
Inola, Okla	42	16	18	43.6	18.
Cottonwood: Emporia, Kans	20	12	13	20.7	12.
Neosho:					
Emporia, Kans	22	12	13	23.6	13.
		18	18	22.5	18.
Iola, Kans	15	12	14	17.1	13.
Chanute, Kans	20	13	15	22.4	13–14.
Oswego, Kans	17	13	18	20.3	16.
Deep Fork: Dewar, Okla	18	15	16	18.6	15.
Poteau: Poteau, Okla	24	14	17	27.0	16.
Petit Jean: Danville, Ark	20	Jan. 25	Mar. 6	27.8	Jan. 25.
Arkansas:					
Arkansas City, Kans	16	19	19	16.2	19.
Webbers Falls, Okla	23	16	16	23.6	16.
Fort Smith, Ark	22	15	18	24.2	16.
Van Buren, Ark	22	14	23	24.9	16.
				22.5	22.
Dardanelle, Ark	22	Jan. 25	Jan. 28	25.8	Jan. 25.
		15	18	23.5	17.
Red Basin					
Little Missouri: Boughton, Ark	20	Jan. 26	Jan. 29	23.9	Jan. 26.
Saline: Benton, Ark	20	Jan. 25	Jan. 28	24.5	Jan. 25.
Ouachita:					
Arkadelphia, Ark	17	Jan. 18	Jan. 21	21.7	Jan. 19.
		Jan. 25	Jan. 30	28.3	Jan. 27.
Camden, Ark	26	Jan. 20	9	44.1	Jan. 29.
		27	Mar. 4	29.0	Mar. 2.
Monroe, La	40	11	Mar. 6	42.5	17–18.
Black: Jonesville, La	50	13	(2)	51.8	Mar. 1–4.
Little: Whitecliffs, Ark	25	Jan. 26	4	31.1	Jan. 28.
Sulphur:					
Hagansport, Tex	38	Jan. 25	1	42.1	Jan. 28.
		14	15	38.5	14.
		24	(2)	42.2	25.
Naples, Tex	22	Jan. 27	8	30.8	Jan. 30.
		20	22	22.2	21.
		25	(2)	29.0	28.
Cypress: Jefferson, Tex	18	3	4	18.6	4.
Red:					
Fulton, Ark	25	Jan. 27	3	32.0	Jan. 30.
Garland, Ark	25	Jan. 28	3	29.9	Jan. 31.
Grand Ecore, La	33	2	8	35.2	4.
Alexandria, La	32	2	12	34.6	6.
Lower Mississippi Basin					
St. Francis:					
Fisk, Mo	20	Jan. 20	26	23.8	Jan. 27–29.
				23.8	2.
				23.5	18–19.
St. Francis, Ark	18	Jan. 22	Mar. 4	22.6	Jan. 28–29.
				22.8	15.
Parkin, Ark	28	4	Mar. 4	29.4	10.
Madison, Ark	32	7	19	32.7	11.
		28	Mar. 2	32.0	28–Mar. 1, 2.
Tallahatchie: Swan Lake, Miss	26	Jan. 4	(2)	30.0	Jan. 9–10.
				20.2	7.
Yazoo:					
Greenwood, Miss	35	Jan. 7	16	38.8	Jan. 12.
				36.0	4.
Yazoo City, Miss	29	Jan. 3	(2)	36.2	10.
Mississippi:					
New Madrid, Mo	34	Jan. 25	Mar. 7	39.6	1.
				38.7	27.
MISSISSIPPI SYSTEM—continued					
Lower Mississippi Basin—Con.					
Mississippi—Continued	Feet			Feet	
Caruthersville, Mo	32	Jan. 26	Mar. 8	38.4	2.
				37.3	28.
Memphis, Tenn	34	2	11	35.2	6.
Red River Landing, La	45	8	(2)	48.0	23.
Baton Rouge, La	35	7	(2)	38.4	23–25.
Donaldsonville, La	28	8	(2)	30.4	22–24.
Reserve, La	22	9	(2)	23.6	22–25.
New Orleans, La	17	9	(2)	18.4	24.
Atchafalaya Basin					
Atchafalaya:					
Simmesport, La	41	15	(2)	42.1	25.
Melville, La	37	6	(2)	39.9	23.
Atchafalaya, La	25	Jan. 17	(2)	28.8	23–Mar. 1.
Morgan City, La	[3] 6	14	16	6.4	26.
		18	(2)		
WEST GULF OF MEXICO DRAINAGE					
Calcasieu: Kinder, La	16	22	22	16.2	22.
Sabine:					
Mineola, Tex	14	18	21	16.5	19.
		25	Mar. 4	18.2	27.
Gladewater, Tex	26	2	9	31.4	5.
Bon Wier, Tex	17	11	12	17.5	12.
Elm Fork: Carrollton, Tex	6	24	24	6.8	24.
East Fork: Rockwall, Tex	10	24	28	17.3	25.
Trinity:					
Dallas, Tex	28	24	27	37.3	24.
Rosser, Tex	26	24	Mar. 2	34.0	27.
Trinidad, Tex	28	25	Mar. 7	30.5	Mar. 2.
Liberty, Tex	24	27	Mar. 2	25.2	28.
Rio Grande:					
Del Rio, Tex	15	25	25	19.5	25
Eagle Pass, Tex	16	25	26	20.5	26.
PACIFIC SLOPE DRAINAGE					
Columbia Basin					
McKenzie:					
Leaburg, Oreg	12	18	19	14.2	18.
Coburg Bridge, Oreg	11	18	19	12.3	18.
Calapooya: Holley Oreg	10.5	18	18	10.8	18.
Santiam: Jefferson, Oreg	13	18	20	19.9	18.
		22	24	16.4	23.
South Yamhill					
Willamina, Oreg	8	10	10	14.8	10.
		17	18	13.5	17.
		22	23	10.1	23.
Whiteson, Oreg	38	10	12	43.4	11.
Molalla: Canby, Oreg	11	19	19	11.8	18.
		23	23	11.0	23.
Tualatin: Dilley, Oreg	12	10	12	13.3	10.
		16	27	13.8	17.
		16	27	13.3	22–23.
Willamette:					
Harrisburg, Oreg	12	18	20	15.3	19.
		23	24	14.1	23.
Corvallis, Oreg	20	20	20	21.1	20.
Albany, Oreg	20	19	20	22.8	20.
Salem, Oreg	20	19	21	23.3	19.
Oregon City, Oreg	12	18	26	15.8	20.
Chehalis Basin					
Satsop: Satsop, Wash	34	22	22	35.0	22.
Chehalis: Grand Mound, Wash	14.5	17	18	16.7	18.
		22	24	16.7	23.
Puget Sound					
Snohomish: Snohomish, Wash	22	17	17	23.0	17

[1] Provisional.
[2] Continued at end of month.
[3] Flood stage or higher reached intermittently.

CLIMATOLOGICAL DATA FOR FEBRUARY 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see REVIEW, January 1943, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

As of January 1, 1949, dewpoint values below 32° F. and relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after January 1, 1949, cannot accurately be combined without necessary conversion.

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	° F.	° F.		° F.			° F.		In.	In.		In.		In.
Alabama	49.0	+4.9	Brewton	84	23	Fayette	12	1	6.20	+0.90	Alberta	10.05	Brantly	2.91
Arizona	40.1	−5.3	Wellton	89	[1] 22	Ft. Valley	−24	14	.76	−.56	Burrus Ranch	3.91	4 stations	.00
Arkansas	46.0	+2.4	Crossett	83	13	Benton	−3	1	3.98	+.43	Buffalo Tower	10.91	Boughton	1.14
California	42.0	−3.9	3 stations	85	[1] 22	Boca	−41	13	2.68	−1.18	Cazadero	16.45	8 stations	.00
Colorado	23.6	−3.6	Eversoll Ranch	76	23	Taylor Park	−43	1	.61	−.36	Wolf Creek Pass	4.71	14 stations	T
Florida	67.9	+7.2	2 stations	92	[1] 8	Milton Exp. Sta	28	1	2.60	−.35	Glen St. Mary	7.37	8 stations	.00
Georgia	55.8	+7.0	do	84	[1] 16	4 stations	20	[1] 2	5.58	+.77	Macon W. B. A. S	9.12	Alapaha Exp. Sta	2.54
Idaho	23.6	−4.5	Grand View	60	17	Island Park Dam	−45	13	2.91	+1.14	Roland (W. Portal)	14.16	Deer Flat Dam	.06
Illinois	31.9	+1.9	Elizabethtown	70	14	Freeport	−15	2	2.63	+.70	Cairo WB City	6.01	Ste. Marie Mission House.	1.07
Indiana	34.8	+4.1	Jeffersonville	70	15	2 stations	−9	5	2.89	+.47	Jeffersonville	4.73	Anderson Quartz Plant.	1.50
Iowa	19.7	−3.1	Keokuk	57	18	do	−31	2	.88	−.22	Tipton	2.39	Rock Rapids	.04
Kansas	32.1	−1.2	Ulysses	76	23	do	−5	1	1.17	+.18	Winfield	3.03	Tribune	.15
Kentucky	43.0	+5.8	Williamsburg	79	14	do	0	1	5.35	+1.87	Turkey Creek School	8.76	Williamsburg	2.16
Louisiana	57.1	+3.3	Camp Polk	90	13	Leesville	5	1	4.82	+.28	Colfax	9.92	Schriever	1.41
Maryland-Delaware	41.9	+8.0	Frederick W. B. A. S., Md.	80	15	Hancock Fruit Lab., Md.	−6	3	3.40	+.53	Lewes, Del	5.16	Luke, Md	1.00
Michigan	24.8	+4.4	Monroe Water Works	58	19	Watersmeet	−26	2	2.10	+.40	Detour, 1 N	4.48	Stambaugh	.31
Minnesota	8.0	−4.5	2 stations	47	23	Warroad	−42	10	.41	−.35	Littlefork Ranger Sta	1.26	Tracy	.00
Mississippi	53.0	+3.5	Houston	87	15	Stoneville Exp. Sta	0	1	5.22	+.26	Bucatunna	11.02	Neshoba	1.21
Missouri	35.1	+1.8	2 stations	72	[1] 12	Albany	−11	2	2.53	+.44	Campbell	5.99	Grant City	1.06
Montana	13.5	−7.8	Lame Deer	60	17	2 stations	−42	13	.95	+.32	Haugan	7.03	Ennis	T
Nebraska	22.1	−4.4	Culbertson	69	22	Niobrara	−22	4	.35	−.34	Omaha	1.44	6 stations	.00
Nevada	26.9	−6.7	2 stations	75	[1] 24	2 stations	−32	[1] 8	.94	−.14	Mt. Charleston Lodge	4.54	3 stations	T
New England	26.8	+4.1	Greenwich, Conn	70	15	Fort Kent, Maine	−30	4	2.85	−.19	Block Island, R. I	6.30	Bennington, Vt	.78
New Jersey	38.0	+7.3	2 stations	77	15	Layton	−12	3	3.68	+.21	Belmar	5.90	Layton	1.00
New Mexico	36.1	−1.1	Santa Rosa	80	23	Dulce	−37	9	.63	−.07	Eick's Ranch	2.86	4 stations	.00
New York	29.1	+6.6	2 stations	74	15	Saranac Lake	−27	6	2.39	−.25	Bridgehampton	5.96	Dansville	.63
North Carolina	49.8	+7.0	do	81	15	Mt. Mitchell	6	11	3.75	−.26	Andrews	7.37	Snake Mountain	1.80
North Dakota	2.1	−7.6	Medora State Park	57	17	Willow City	−40	3	.46	−.01	Grafton State School	.94	5 stations	.05
Ohio	36.5	+7.0	2 stations	71	15	Millport, 2 NW	−5	3	2.70	+.11	Peebles	4.30	Warren	1.50
Oklahoma	40.3	−.8	Smithville	75	22	Hulah Dam	−2	1	2.23	+.73	Konawa	6.57	Kenton, 5 N	T
Oregon	32.8	−2.5	2 stations	70	[1] 25	Austin, 3 S	−30	13	5.93	+2.71	Valsetz	33.91	Voltage	.08
Pennsylvania	35.2	+6.8	Columbia	78	15	Phillipsburg, 7 E	−13	3	2.60	−.16	Kregar, 4 SE	5.04	Lawrenceville	1.01
South Carolina	53.8	+6.3	Yemassee	84	17	Rainbow Lake	20	3	5.08	+.91	Saluda	6.99	Charleston, WB City	2.86
South Dakota	13.8	−5.5	Wood	59	22	Ralph	−30	2	.14	−.42	Timber Lake	.84	4 stations	.00
Tennessee	45.7	+4.5	Moscow	80	14	Ashwood	−1	1	3.42	−1.06	Haw Knob	5.80	Mason	1.47
Texas	51.0	−.3	Rio Grande City	94	14	Lampasas	−11	1	2.37	+.59	Beaumont	9.26	3 stations	.00
Utah	20.6	−9.4	2 stations	64	[1] 22	Woodruff	−37	13	.90	−.30	Silver Lake (Brighton)	5.11	Thompsons	.00
Virginia	44.3	+6.9	3 stations	80	14	Front Royal Ap	8	3	2.70	−.34	Cheriton	5.72	Glen Lyn	1.04
Washington	30.0	−5.2	Mossyrock	72	[1] 25	Chewelah, 2 S	−30	5	6.25	+2.44	Wind River	27.82	Ephrata	.31
West Virginia	41.1	+7.6	Kearneysville, 1 NW	79	15	Berkeley Springs	−2	3	3.22	+.10	Pickens, No. 1	8.47	2 stations	1.26
Wisconsin	18.0	+.8	Richland Center	54	18	Hatfield Power Co. Dam.	−40	2	.80	−.38	Racine	2.42	Dodge	.02
Wyoming	18.8	−3.5	Guernsey Dam	68	22	Big Piney	−42	1	.54	−.23	Moose	5.01	4 stations	.00
Alaska (Jan.)	4.8	+1.9	Beaver Falls	53	27	Allakaket	−55	15	3.24	+.90	Little Port Walter	27.74	Unalakleet	.07
Hawaii	68.4	−.4	Kaanapai	86	23	Haleakala Ranger Sta	32	23	7.10	+.19	Iliiliula Intake	32.60	Mahukona	.00
Puerto Rico	72.0	−.5	Ponce	92	[1] 2	Juncos (3)	50	[1] 2	1.30	−1.51	Rio Blanco (1,800 ft. elev.).	7.41	Ensenada (8)	.00

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR FEBRUARY 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Speed of fastest mile: Miles per hour	Speed of fastest mile: Direction	Speed of fastest mile: Date	Character of day (sunrise to sunset) Number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
NEW ENGLAND	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	° F.	° F.	° F.	° F.	° F.		° F.			° F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
									27.8	+5.2							72	3.40	.0														6.3	
Caribou [3]	628	5	33	994.2	1,018.8	------	22	−1	10.7	0	41	9	−24	4	1,523	4	72	2.21	+.3	.56	12	0	31.5	27.0	13.1	nw.	--	------	--	5	10	13	6.7	--
Eastport	75	67	82	1,015.9	1,019.0	+5.1	33	18	25.4	+3.9	51	19	−3	12	1,110	----	--	4.35	+1.0	1.66	12	0	26.0	1.0	13.1	n.	34	nw.	17	9	5	14	6.0	55
Portland, Me. [3]	103	6	43	1,016.6	1,019.0	+3.4	36	17	26.2	+5.4	56	19	−12	12	1,085	20	74	3.14	−.9	.93	11	0	11.5	T	8.5	n.	47	w.	17	8	8	12	6.0	61
Concord [3]	289	5	45	1,006.8	1,019.5	+3.6	38	16	27.0	+6.7	60	19	−12	3	1,065	18	68	1.83	−1.1	.56	10	0	5.4	T	7.5	nw.	34	nw.	11	9	7	12	6.1	46
Mt. Washington	6,274	5	37	799.2	1,020.3	------	18	2	10.3	+5.3	35	15	−18	11	1,540	----	--	2.82	−2.7	.64	14	0	23.1	14.0	45.5	w.	--	------	--	3	6	19	8.0	28
Burlington [3]	403	6	51	1,006.4	1,019.3	+2.7	33	15	23.9	+4.5	48	15	−12	6	1,151	17	71	2.08	+.5	.66	9	0	11.6	1.0	10.5	s.	45	s.	12	2	12	14	7.4	39
Boston [3]	124	33	62	1,019.0	1,019.9	+4.3	42	27	34.4	+5.6	61	19	7	12	855	23	65	3.25	−.1	1.19	11	0	6.9	T	12.5	nnw	40	nw	17	8	9	11	6.3	57
Nantucket [2]	12	4	34	1,019.0	1,019.5	+4.6	42	29	35.4	+4.7	52	14	16	12	832	30	79	4.17	+.8	1.02	13	2	4.5	T	15.8	wnw	54	e	28	5	8	15	6.9	41
Block Island	26	11	46	1,019.0	1,019.8	+4.2	43	30	36.6	+6.2	54	15	14	12	788	31	80	6.32	+2.7	2.10	13	0	10.5	7.0	17.6	nw	57	n	28	9	8	11	5.8	62
Providence [3]	159	65	60	1,017.6	1,019.8	+3.5	45	28	36.3	+7.3	65	15	8	12	801	24	68	3.66	.0	.98	12	0	11.4	2.0	9.2	nw	33	nw	17	12	3	13	5.1	64
Hartford [3]	159	5	44	1,019.6	1,020.5	+3.9	42	24	33.0	+5.8	58	15	6	3	897	25	73	3.32	−.5	1.86	11	0	13.4	7.0	8.8	n	33	nw	17	8	7	13	5.7	61
New Haven [2]	107	5	39	1,020.0	1,020.2	+3.3	43	27	34.8	+6.9	57	9	9	3	844	27	60	3.59	−.1	1.50	14	0	14.3	10.0	7.2	n	21	se	22	10	5	13	5.9	60
MIDDLE ATLANTIC																																		
									40.2	+7.6							68	3.03	−.2														6.3	
Albany [3]	97	6	40	1,008.8	1,019.7	+2.4	38	20	29.2	+7.9	59	19	−8	6	999	21	71	1.52	−.9	.47	8	0	7.8	2.0	11.5	sse	39	w	26	6	10	12	6.8	55
Binghamton [4]	871	57	79	988.5	1,020.1	+2.8	42	23	32.6	+8.6	65	15	0	3	904	22	69	1.91	−.4	.53	14	0	5.9	1.0	6.9	w	26	sw	7	5	8	15	7.0	51
New York [4]	314	415	454	1,019.6	1,021.3	+4.0	47	31	38.9	+7.6	71	15	18	12	731	27	63	3.70	−.1	1.11	10	1	10.3	7.0	15.9	nw	54	nw	17	9	7	12	5.9	56
Allentown [3]	385	4	58	1,006.8	1,021.3	------	44	25	34.4	+4.6	71	15	1	3	857	26	71	2.37	−.9	.57	10	0	4.1	2.0	8.1	w	--	------	--	7	10	11	6.0	--
Harrisburg [3]	374	30	49	1,007.8	1,021.0	+2.7	46	28	37.2	+7.0	71	15	5	3	776	26	67	2.41	−.6	.61	10	0	7.9	1.0	7.7	wnw	38	nw	28	8	5	15	6.4	55
Philadelphia [4]	114	174	150	1,020.0	1,021.0	+2.7	48	34	40.8	+6.9	73	15	19	12	675	30	69	3.82	+.5	.83	10	0	7.5	2.0	7.6	s	24	nw	25	9	8	11	5.6	58
Reading	323	47	306	1,008.8	1,020.7	+2.4	47	30	38.5	+8.0	76	15	10	3	747	----	--	2.72	−.7	.67	10	0	9.1	2.0	11.7	nw	42	nw	17	6	8	14	6.4	56
Scranton	805	72	104	990.9	1,020.3	+2.3	43	26	34.1	+6.8	67	15	4	3	863	----	--	1.68	−1.	4.39	11	0	5.0	3.0	7.0	nw	33	nw	17	7	11	10	6.0	51
Atlantic City	52	37	172	1,018.6	1,021.0	+3.4	48	34	41.0	+7.	61	15	21	12	672	33	73	4.99	+1.6	1.33	10	1	2.4	T	16.4	n	41	nw	28	9	4	15	6.2	58
Newark [3]	30	5	46	1,019.3	1,020.5	------	46	30	38.2	+8.4	76	15	15	3	754	27	65	3.69	+.2	1.13	10	0	8.0	4.0	10.3	sw	--	------	--	8	7	13	6.0	--
Trenton	190	89	107	1,013.9	1,020.7	+3.1	46	31	38.8	+8.1	73	15	15	3	734	----	--	3.11	−.2	.70	10	0	8.4	3.0	9.2	nw	29	sw	15	8	9	11	5.7	56
Baltimore [4]	123	100	215	1,020.7	1,021.5	+2.9	51	37	43.9	+8.5	77	15	23	3	592	31	66	3.41	.0	.72	12	0	8.9	2.0	10.9	s	65	nw	28	9	7	12	6.0	53
Washington [4]	112	56	100	1,019.3	1,021.5	+2.9	53	36	44.6	+9.3	77	15	24	3	576	33	68	3.27	.0	.78	11	1	4.7	T	8.2	s	29	nw	28	5	8	15	6.6	51
Cape Henry	18	8	54	1,020.7	1,021.3	+3.3	55	42	48.6	+7.4	78	15	29	12	465	----	--	3.71	+.5	.88	11	2	.0	.0	12.7	sw	45	nw	28	5	11	12	6.5	53
Lynchburg [3]	686	5	58	987.1	1,021.5	+2.9	55	36	45.4	+7.1	74	14	23	3	550	33	66	2.50	−.6	.61	10	0	2.4	T	7.4	sw	36	s	15	6	9	13	6.6	53
Norfolk [4]	91	80	125	1,020.7	1,022.0	+3.4	57	43	50.0	+7.3	77	15	32	28	420	39	73	4.27	+1.0	1.11	12	3	.0	.0	9.9	ne	34	sw	15	4	8	16	7.2	60
Richmond [4]	144	11	52	1,015.2	1,021.3	+2.3	57	38	47.8	+8.2	79	14	25	3	487	36	60	2.50	−.7	.66	10	2	T	.0	8.4	s	31	sw	15	6	11	11	6.4	63
SOUTH ATLANTIC																																		
									54.2	+7.2							74	4.09	+.4														7.1	
Asheville	2,253	77	92	------	1,022.2	+2.6	56	37	46.7	+8.2	75	13	22	28	517	36	--	3.24	+.1	1.25	11	0	.2	.0	9.9	se	35	nw	28	6	6	16	6.9	59
Charlotte [4]	779	63	86	994.2	1,022.1	+3.1	59	43	51.1	+7.2	76	14	30	3	390	40	70	3.32	−.9	.97	10	0	.0	.0	7.3	ne	26	sw	14	5	3	20	7.3	56
Greensboro [3]	886	6	56	989.8	1,022.4	+3.1	57	37	47.2	+7.8	75	14	21	3	495	36	69	2.95	−.8	.76	9	2	T	.0	9.5	sw	35	sw	15	4	10	14	6.7	57
Hatteras	11	5	47	1,021.7	1,021.9	+3.6	59	48	53.6	+6.2	69	19	34	12	319	48	84	3.35	−.7	.90	11	1	.0	.0	13.4	ne	42	nw	10	2	10	16	7.6	65
Raleigh [4]	376	5	71	1,006.1	1,022.2	+3.2	59	41	50.0	+6.8	78	14	29	3	420	40	73	3.10	−.8	1.10	11	2	.0	.0	7.6	nw	32	s	13	3	12	13	6.4	37
Wilmington	72	73	107	1,020.7	1,022.2	+2.9	64	48	55.8	+7.9	77	14	36	2	268	48	--	3.70	+.4	1.03	13	1	T	.0	10.1	ne	32	nw	10	4	11	13	6.7	57
Charleston [4]	48	11	92	1,020.3	1,021.8	+2.5	66	52	58.8	+6.4	80	14	37	1	196	49	75	2.56	−.4	1.03	8	1	.0	.0	10.2	sw	32	sw	10	5	6	17	7.1	56
Columbia, S. C. [4]	347	70	91	1,013.5	1,022.0	+2.7	64	47	55.6	+7.4	78	14	34	11	268	45	75	6.12	+2.4	1.78	12	2	T	.0	8.5	ne	32	sw	15	4	7	17	7.4	43
Greenville, S. C. [3]	1,040	18	36	984.1	1,021.8	+3.5	59	41	49.8	+6.5	74	14	25	1	422	39	71	5.65	+.5	1.85	11	0	.0	.0	8.3	ne	42	w	10	5	5	18	7.3	50
Augusta [4]	182	62	77	1,007.5	1,022.0	+3.0	66	47	56.4	+6.5	80	15	32	1	250	44	69	5.29	+1.2	2.07	11	2	.0	.0	6.0	nw	24	w	15	5	5	18	7.3	57
Savannah [2]	65	19	51	1,020.0	1,022.0	+2.7	69	52	60.2	+7.8	81	16	37	1	161	51	76	3.79	+.6	.93	13	3	.0	.0	10.5	sse	39	w	10	3	6	19	7.4	41
Jacksonville [4]	43	86	110	1,020.0	1,021.8	+2.2	73	58	65.6	+7.6	82	9	42	1	66	57	79	6.04	+3.1	3.77	10	1	.0	.0	8.4	ne	50	w	10	4	9	15	7.0	44
FLORIDA PENINSULA																																		
									73.2	+6.4							74	.49	−1.5														4.7	
Key West [4]	21	10	64	1,019.3	1,020.2	+1.6	81	71	76.2	+5.7	84	7	67	11	0	66	73	.66	−.7	.26	6	0	.0	.0	9.3	e.	24	e.	12	14	11	3	4.0	70
Miami [4]	25	242	249	1,019.3	1,020.7	+1.4	78	69	73.3	+5.3	84	10	57	11	0	63	71	.48	−1.6	.27	5	0	.0	.0	13.4	se.	34	se.	18	9	19	0	4.0	85
Tampa [3]	35	5	36	1,020.3	1,021.0	+1.4	80	60	70.0	+8.1	87	23	48	11	9	61	77	.34	−2.2	.17	5	0	.0	.0	7.3	e.	25	w.	10	7	11	10	6.0	60
EAST GULF																																		
									57.3	+5.6							76	5.49	+.9														7.6	
Atlanta [3]	1,173	33	72	1,020.3	1,021.7	+2.4	61	42	51.6	+6.3	77	14	26	1	378	40	68	4.11	−1.0	.94	12	3	.0	.0	10.9	nw.	36	nw.	10	3	9	16	7.0	44
Macon [4]	370	79	87	1,008.5	1,021.8	+1.8	65	46	55.8	+6.5	78	22	30	1	270	45	69	6.78	+2.4	1.78	12	2	.0	.0	6.6	s.	27	nw.	10	5	7	16	7.1	46
Apalachicola	35	11	51	1,019.6	1,020.7	+1.4	69	58	63.7	+7.4	78	23	40	1	78	----	--	4.08	+.2	1.49	8	2	.0	.0	8.7	se.	31	se.	7	7	4	17	6.7	58
Pensacola [4]	56	54	79	1,021.2	1,022.7	+3.1	69	55	62.0	+6.8	78	23	30	1	123	55	--	4.47	+.1	1.24	15	4	.0	.0	7.9	e.	24	nw.	16	2	6	20	8.1	46
Anniston	618	6	32	999.3	1,021.9	+1.9	62	41	51.8	------	78	14	25	1	377	44	76	7.26	+1.8	1.65	13	4	.0	.0	7.8	ene.	37	wnw.	10	4	13	11	7.8	--
Birmingham [3]	700	5	63	998.6	1,021.8	+1.8	62	42	51.6	+5.1	77	15	24	1	378	43	75	8.29	+3.2	1.75	13	3	T	.0	9.8	ene.	30	sw.	15	4	4	20	7.8	30
Mobile [4]	57	86	161	1,012.5	------	------	69	53	61.0	+6.3	78	9	31	1	144	53	80	7.32	+2.0	2.97	15	4	.0	.0	10.7	n.	37	nw.	10	3	6	19	7.7	38
Montgomery [4]	218	92	105	1,013.9	1,021.4	+1.4	65	49	56.9	+5.3	80	15	30	1	237	47	75	5.16	−.3	1.30	13	0	.0	.0	7.4	n.	24	s.	15	5	4	19	7.6	41
Meridian [4]	375	67	92	1,009.8	1,021.4	+1.8	64	44	54.4	+4.8	80	13	24	1	319	47	80	5.44	.0	2.34	14	4	.0	.0	7.4	nne.	--	------	--	5	2	21	8.0	--
Vicksburg [4]	247	82	102	1,011.5	1,020.9	+.9	62	46	54.2	+2.4	81	13	20	1	316	46	--	5.34	+.5	2.01	11	5	.0	.0	8.6	n.	27	s.	14	4	4	20	7.9	30
New Orleans C. O.	53	76	84	1,018.3	------	------	69	56	62.6	+5.3	80	13	32	1	120	----	--	4.73	+.5	1.33	14	0	.0	.0	6.7	n.	17	nw.	27	2	7	19	7.8	27
New Orleans A. P. [3]	30	6	52	1,018.3	1,020.3	+.7	69	55	61.8	------	80	9	32	1	133	56	83	2.85	------	----	13	1	.0	.0	7.8	ne.	--	------	--	3	4	21	8.1	--

See footnotes at end of table

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR FEBRUARY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity [4]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Speed of fastest mile: Miles per hour	Speed of fastest mile: Direction	Speed of fastest mile: Date	Character of day (sunrise to sunset) number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
West Gulf	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.			°F.	%	In.	In.	In.			In.	In.	m.p.h.					0-3	4-7	8-10	0-10	%
									55.5	+2.3							79	3.81	+1.4														7.8	
Shreveport [2]	181	5	64	1,014.9	1,020.5	+.9	63	43	53.0	+2.0	82	13	10	1	342	46	78	3.72	+.4	1.84	10	2	T	.0	8.4	sse.	30	se.	12	4	4	20	7.5	42
Fort Smith [2]	463	6	30	1,003.1	1,020.1	+1.1	57	33	45.0	+2.2	70	12	17	1	561	35	72	5.99	+3.4	3.23	9	5	T	.0	7.1	ne.	26	sw.	11	12	4	12	5.2	63
Little Rock [2]	265	26	58	1,007.8	1,021.4	+1.8	58	37	47.6	+2.7	77	14	18	1	476	40	76	4.04	+.2	1.62	8	1	.0	.0	7.6	ne.	45	nw.	14	9	4	15	6.1	50
Austin [2]	621	5	41	996.6	1,019.4	+1.4	64	46	55.3	+1.9	78	14	17	1	278	48	79	2.35	.0	1.93	9	3	.0	.0	8.4	ne.	33	nw.	14	2	5	21	8.3	31
Brownsville [2]	20	5	54	1,011.2	1,016.9	+.3	73	59	66.1	+3.5	85	14	42	2	81	60	87	3.10	+1.6	1.56	12	1	.0	.0	11.5	se.	35	s.	12	2	4	22	8.4	17
Corpus Christi [2]	44	6	33	1,015.9	1,018.6	+.6	69	55	62.2	+5.5	84	14	40	2	141	56	85	2.25	+.8	1.81	11	2	.0	.0	11.2	nne.	48	se.	13	1	3	24	9.1	28
Dallas [2]	488	34	45	1,001.7	1,020.1	+1.1	58	39	48.4	−1.6	73	12	8	1	465	41	76	3.66	+1.4	2.67	8	3	T	.0	8.1	ne.	39	se.	12	8	5	15	6.4	42
Fort Worth [2]	706	40	56	994.2	1,020.2	+1.6	59	38	48.6	+1.3	73	8	14	1	457	39	74	4.75	+3.0	3.08	11	4	T	.0	12.2	s.				9	3	16	6.3	
Galveston [4]	54	122	129	1,018.6	1,019.5	+.5	63	54	58.8	+2.5	72	21	36	1	185	56	91	2.61	−.2	1.15	13	2	.0	.0	12.1	e.	34	e.	25	1	5	23	8.8	33
Houston [4]	138	157	190	1,016.6	1,019.7	+.7	66	52	59.4	+3.5	80	24	29	1	188	54	84	5.40	+2.2	1.96	15	7	.0	.0	10.1	se.	33	se.	25	0	3	25	9.1	19
Laredo [2]	418	10	38	998.6	1,017.6		71	54	62.5	+2.0	93	13	36	2	160	52	74	1.43	+.6	.43	9	4	.0	.0	9.0	se.				2	1	25	8.9	
Palestine	510	64	72	1,001.7	1,020.0	+.7	64	45	54.3	+3.1	80	24	18	1	307	45	70	2.41	−.6	.84	13	1	.0	.0	7.3	s.	27	s.	12	4	6	18	7.5	48
Port Arthur [4]	34	59	134	1,018.6	1,019.5	+.9	65	53	59.0	+1.9	77	21	28	1	194	54	87	8.59	+5.0	4.80	15	5	.0	.0	13.3	n.	42	e.	25	0	8	20	8.4	35
San Antonio [2]	704	6	51	989.8	1,018.9	+.9	65	50	57.4	+2.0	82	14	28	1	240	47	75	2.98	+1.3	1.96	9	2	.0	.0	9.2	ne.	31	se.	25	1	5	22	8.6	29
Ohio Valley and Tennessee									40.7	+5.6							74	3.30	−.9														6.6	
Chattanooga [2]	762	6	66	996.6	1,022.1	+2.1	59	38	48.6	+6.4	76	14	24	3	454	39	71	4.94	+.1	1.69	12	0	.0	.0	6.2	s.	35	w.	15	4	8	16	7.1	35
Knoxville [2]	995	27	71	986.1	1,021.8	+2.2	58	38	47.8	+7.0	75	14	24	3	486	37	69	2.86	−1.6	.88	10	1	T	T	10.0	ne.	33	sw.	15	3	10	15	7.1	50
Memphis [2]	399	5	49	1,010.8	1,021.5	+1.5	55	38	46.4	+2.1	77	15	16	1	521	38	72	1.90	−2.5	.82	7	1	.0	.0	7.8	e.	28	s.	15	7	4	17	6.4	52
Nashville [2]	546	5	72	999.3	1,021.8	+1.5	56	34	45.0	+3.4	76	14	7	1	561	37	76	2.94	−1.2	1.50	8	1	.0	.0	8.4	sse.	31	nw.	28	8	5	15	6.5	44
Lexington [2]	989	4	58	985.1	1,021.8	+2.2	50	31	40.6	+5.2	66	15	9	1	682	32	74	5.86	+2.2	2.67	9	0	T	.0	12.8	wnw.				8	6	14	6.2	
Louisville [2]	525	5	54	1,003.4	1,021.5	+1.5	51	32	41.4	+5.4	69	14	10	1	662	31	70	4.06	+.5	1.94	8	1	T	.0	8.4	w.	43	sw.	15	8	7	13	6.5	47
Evansville [2]	431	6	40	1,007.1	1,021.9	+2.3	48	29	38.5	+3.6	68	14	8	1	731	31	78	3.51	+.3	2.05	7	1	T	T	8.4	wnw.	30	nw.	15	9	4	15	6.4	45
Indianapolis [2]	823	5	54	990.9	1,021.2	+2.2	44	26	35.0	+4.7	61	12	12	2	838	28	77	2.38	−.4	1.55	9	3	T	T	11.4	se.	56	nw.	28	8	3	17	6.4	44
Terre Haute [2]	575	4	36	999.3	1,021.7	+2.4	45	26	35.5	+4.2	62	12	10	1	822	28	76	2.62	.0	1.89	9	2	T	T	11.2	sse.	36	s.	13	8	3	17	6.7	51
Cincinnati [4]	627	135	148	988.8	1,021.6	+3.3	50	33	41.6	+7.2	67	15	17	1	660	30	74	3.22	+.2	1.75	9	1	T	T	5.3	nw.	25	nw.	28	7	7	14	6.4	49
Columbus [4]	822	90	110	990.2	1,021.1	+2.1	46	30	38.0	+7.3	64	15	11	1	758	28	75	2.53	−.1	.99	13	0	.1	T	6.6	sw.	37	s.	15	10	2	6	6.1	51
Dayton [2]	1,003	6	55	983.7	1,021.1	+2.5	44	27	35.4	+5.5	62	15	7	2	830	28	76	2.65	.0	1.62	11	2	T	T	12.1	w.	39	s.	15	9	3	16	6.5	47
Elkins [2]	1,947	5	45	948.5	1,020.0	+.4	48	26	37.2	+6.2	66	15	10	3	782	30	76	4.05	+1.0	.68	15	2	7.1	2.0	7.9	wnw	39	nw.	15	4	6	18	7.4	40
Parkersburg	637	77	84				52	31	41.4	+7.2	69	15	16	3	659			3.31	+.2	1.11	14	0	.4	T	7.4	nw.	30	nw.	10	6	6	16	6.9	37
Pittsburgh [2]	842	39	54	973.6	1,020.3	+2.0	47	28	37.8	+8.0	67	15	12	3	761	27	68	2.62	.0	.81	14	1	1.5	T	10.1	nw.	34	nw.	22	6	5	17	7.0	38
Lower Lakes									31.5	+7.2							74	2.44	.0														7.2	
Buffalo [2]	768	34	96	992.9	1,019.2	+2.3	41	22	31.8	+8.1	59	15	10	11	930	23	73	2.64	−.3	.87	13	0	5.2	1.0	14.5	sw.	52	sw.	7	3	6	19	7.6	47
Canton	448	10	61	1,001.7	1,018.7	+2.1	34	13	23.7	+7.9	55	15	−17	6	1,155	16	74	3.24	+1.0	1.03	15	0	15.4	4.0	9.4	w.	31	w.	18	5	11	12	7.0	49
Oswego	335	71	85				38	23	30.5	+7.8	59	15	6	12	965			2.43	−.3	.48	14	0	13.9		10.7	se.	32	nw.	17	4	6	18	7.5	34
Rochester [2]	523	4	69	999.0	1,019.2	+1.9	40	21	30.6	+6.7	61	18	4	6	960	23	74	1.88	−.8	.41	13	0	10.6	1.0	11.3	wsw.	45	w.	15	4	9	15	7.1	51
Syracuse [2]	596	5	57	1,004.4	1,019.7	+2.4	41	21	30.6	+7.7	63	15	5	11	960	22	69	2.04	−.7	.55	13	0	12.5	2.0	10.3	wsw.	61	w.	17	2	9	17	7.6	50
Erie [4]	714	57	81	992.9	1,019.5	+1.9	43	26	34.7	+7.8	63	15	12	3	846			2.05	−.5	.58	16	0	5.0	2.0	9.0	w.	27	se.	6	3	8	17	7.4	40
Cleveland [2]	762	27	54	991.5	1,020.0	+2.0	44	25	34.2	+7.9	61	15	5	2	862	26	76	2.39	−.1	.81	13	0	3.6	3.0	12.4	s.	35	w.	7	6	6	16	7.0	41
Sandusky	629	5	67	996.3			43	26	34.6	+7.2	62	18	12	2	851			2.01	−.1	1.10	11	0	.6	T	10.4	s.	30	w.	28	6	7	15	6.7	40
Toledo [2]	628	5	47	995.9	1,020.0	+1.4	41	24	32.4	+6.4	59	19	5	2	913	25	76	2.56	+.5	1.75	11	0	.6	T	12.4	sw.	36	w.	7	7	4	17	6.8	50
Fort Wayne [2]	857	5	34	980.2	1,020.4	+1.8	40	24	32.3	+5.7	57	19	7	2	918	25	78	2.93	+.6	1.71	13	3	3.6	1.0	9.7	nw.	34	sw.	13	7	3	18	7.0	45
Detroit [2]	730	5	77	996.3	1,019.9	+1.9	38	23	30.7	+5.9	56	18	9	6	962	22	72	2.68	+.5	1.20	14	0	3.1	T	11.7	nw.	35	nw.	28	4	6	18	7.5	37
Upper Lakes									21.9	+3.7							76	1.66	−.1														7.3	
Alpena	609	5	89	995.3			32	18	24.8	+6.8	50	18	5	11	1,125			2.09	+.4	.55	14	0	17.9	3.0	11.6	nw.	35	e.	6	4	7	17	7.7	39
Escanaba	612	51	72	994.6			28	11	19.3	+3.9	48	18	−5	2	1,281			.92	−.6	.23	12	0	11.5	7.0	10.8	s.	36	n.	28	6	9	13	6.5	56
Grand Rapids [4]	707	70	244	992.9	1,019.0	+1.0	35	23	29.2	+5.5	53	18	13	2	1,005	22	79	1.95	−.3	.71	16	0	7.3	1.0	12.9	sw.	52	sw.	18	1	6	21	8.4	26
Lansing [4]	878	5	90	986.1	1,019.2	+1.6	35	20	27.4	+5.2	53	18	8	6	1,056	22	78	2.47	+.6	.84	14	0	4.9	1.0	14.0	sw.	42	w.	28	3	6	19	7.8	35
Marquette	734	44	73	986.1			27	12	19.4	+3.1	43	18	−2	2	1,284			1.30	−.6	.34	16	0	24.8	19.0	9.2	w.	29	s.	17	2	3	23	8.6	28
Sault Sainte Marie [2]	614	10	52	989.8	1,017.7	+.1	26	11	18.4	+7.0	44	18	−5	11	1,301	12	77	2.06	+.6	.64	18	0	29.9	13.0	11.3	e.	34	sw.	15	1	7	20	8.1	32
Chicago [2]	673	5	38	996.6	1,020.0	+1.4	36	20	27.8	+2.9	55	18	0	5	1,039	21	76	2.42	+.3	1.25	8	0	5.9	.0	10.8	ssw.	29	nw.	28	9	3	16	6.4	48
Green Bay	617	5	32	994.9			28	9	18.4	+1.0	44	18	−11	2	1,306			1.08	−.5	.29	13	1	12.9	T	8.7	s.	31	se.	11	8	3	17	6.8	53
Milwaukee [2]	681	33	66	992.9	1,019.2	+1.2	31	16	23.5	+2.3	44	18	−7	2	1,158	17	73	1.74	−.1	.89	10	1	9.5	T	14.2	ssw.	40	sw.	18	7	8	13	6.4	47
Duluth [4]	1,133	5	47	963.8	1,018.4	+.1	21	1	11.0	−.4	33	23	−22	2	1,514	2	74	.59	−.5	.13	12	0	5.9	11.0	10.8	nw.	34	nw.	8	9	5	14	6.0	52
North Dakota									1.5	−6.0							75	.46	−.1														6.7	
Fargo [2]	940	5	47	984.4	1,020.1	−.2	14	−9	2.3	−5.8	32	17	−24	4	1,755	−4	75	.53	−.2	.21	11	0	5.6	9.0	14.3	nnw.	38	s.	10	5	9	14	6.5	66
Bismarck [2]	1,677	5	41	955.6	1,019.9	−.8	14	−9	2.2	−6.3	44	17	−28	20	1,756	−4	75	.37	−.1	.19	8	0	9.5	10.0	9.9	nnw.	34	nw.	11	6	4	18	7.0	65
Devils Lake	1,478	11	44	962.4			9	−12	−1.4	−6.5	41	17	−27	4	1,861			.53	.0	.19	9	0	6.8	23.0	8.8	nw.	34	nw.	17	6	11	11	6.1	58
Williston	1,878	42	50	946.8			14	−8	3.0	−5.2	45	17	−24	2	1,734			.39	.0	.17	7	0	4.0	9.0	6.0	sw.	26	nw.	18	5	6	17	7.1	63
Upper Mississippi									24.8	+.4							76	1.77	+.1														5.9	
Minneapolis-St. Paul [2]	919	43	74	986.8	1,019.2	+.6	24	2	13.4	−2.5	47	23	−18	2	1,449	5	70	.14	−.8	.04	8	0	3.4	2.0	10.5	se.	34	se.	11	10	3	15	6.1	50
La Crosse [2]	672	5	29	993.6	1,019.3	+.3	27	4	15.8	−1.2	42	18	−25	2	1,378	11	75	.44	−.6	.19	8	0	5.9	2.0	10.2	nw.	31	nw.	24	8	11	9	6.5	61
Madison [2]	974	27	39	986.8	1,019.6	+.6	30	10	19.9	+.8	43	18	−16	2	1,264	14	73	1.26	−.2	.67	11	1	9.3	1.0	12.9	w.	40	nw.	24	8	7	13	6.0	54
Charles City	1,015	10	51	981.4	1,020.3	+.7	26	6	16.2	−.9	42	18	−20	2	1,368			.44	−.7	.20	7	0	4.3	1.0	7.1	nw.	21	s.	11	9	7	12	5.5	51
Moline [2]	606	6	50	998.0	1,021.1	+1.5	34	16	24.8	+1.3	51	18	−4	2	1,126	18	74	1.78	+.2	1.07	10	0	2.5	.0	11.3	wnw	34	s.	17	11	4	13	5.5	48
Des Moines [4]	860	5	99	984.1	1,020.8	+1.5	31	11	21.0	−2.7	48	23	−11	2	1,229	15	76	1.06	−.1	.85	5	0	6.0	T	10.2	nw.	29	nw.	9	11	5	12	5.6	52
Dubuque	699	60	79	993.6	1,020.3	+1.0	32	13	22.2	.0	40	18	−12	2	1,197	16	77	1.50	+.1	1.01	7	0	9.3	3.0	5.9	nw.	18	s.	11	10	6	12	5.6	55
Burlington [2]	702	4	36	994.2	1,020.9	+1.3	34	16	25.3	−1.1	53	18	−2	4	1,112	21	82	1.78	+.1	1.19	8	0	4.2	T	10.7	wnw	34	nw.	27	11	5	12	5.6	53
Cairo	357	5	99	1,002.5			51	35	42.9	+4.4	60	14	20	1	618			6.01	+2.9	4.30	7	3	.0	.0	9.1	s.	31	sw.	14	8	5	15	6.0	59
Peoria [2]	609	7	26	998.0	1,021.0	+1.4	36	19	27.5	+.3	54	18	−2	5	1,050	22	77	1.63	−.4	.50	8	0	3.8	.0	12.8	s.	35	s.	11	9	4	15	6.3	46
Springfield, Ill. [4]	636	5	191	998.0	1,021.1	+2.1	40	23	31.3	+3.7	58	18	5	5	944	25	79	2.65	+.3	1.29	8	1	4.5	.0	13.5	nw.	38	se.	11	9	4	15	6.2	56
St. Louis [4]	568	33	59	1,000.0	1,021.0	+1.4	46	28	37.1	+2.3	66	18	19	28	782	28	76	2.60	.0	2.00	6	0	.5	.0	12.2	s.	35	s.	13	11	3	14	5.7	53

See footnotes at end of table

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR FEBRUARY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level[1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air: Averages: Mean maximum	Mean minimum	Mean	Departure from normal	Extremes: Highest	Date	Lowest	Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity[4]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed of fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover,[7] tenths (sunrise to sunset)	Possible sunshine
Missouri Valley	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F	°F	°F.	°F.	°F		°F.			°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
									24.6	−1.6							75	1.10	−.1														5.8	
Columbia, Mo.[4]	784	6	66	990.9	1,020.6	+1.3	44	25	34.4	+2.0	70	12	10	2	856	26	77	1.95	−.1	.69	9	1	.6	.0	8.4	s.	24	sw.	11	8	9	11	5.9	54
Kansas City[3]	963	38	76	992.2	1,020.9	+1.6	41	24	32.4	+1.2	61	18	7	2	913	24	72	1.36	−.1	.64	10	0	2.2	.0	9.1	ssw.	30	s.	7	9	5	14	6.2	56
St. Joseph[3]	967	5	51	989.5	1,020.8	+1.5	37	18	27.4	−2.2	54	23	3	1	1,050	20	74	1.58	−.1	.83	9	2	2.7	.0	12.1	nnw.	30	s.	7	13	3	12	5.2	57
Springfield, Mo.[3]	1,324	5	50	973.9	1,020.6	+1.6	49	28	38.6	+4.6	66	12	9	1	739	28	72	2.50	+.2	1.42	8	2	.1	.0	13.2	sse.	35	se.	11	11	5	12	5.4	55
Topeka[4]	987	65	87	987.5	1,020.9	+1.9	39	23	31.0	.0	60	18	8	2	951	23	77	1.85	+.3	.79	8	3	2.3	.0	8.9	s.	25	sw.	11	9	7	12	6.0	48
Lincoln[4]	1,189	6	81	975.6	1,020.8	+1.2	31	14	22.6	−3.5	45	23	−4	2	1,189	16	79	1.16	+.2	.80	6	0	10.7	T	8.9	s.	28	nw.	24	9	3	16	6.3	53
Norfolk, Nebr.[3]	1,551	5	38	961.7	1,020.3	......	26	5	15.8	−7.5	42	23	−17	1	1,378	10	78	.04	−.8	.03	2	0	.7	9.0	......	s.	..	......	..	10	5	13	5.9	..
Omaha[3]	1,105	5	68	963.4	1,020.9	+.9	30	10	20.4	−3.9	46	11	−12	2	1,247	14	75	1.44	+.6	1.08	6	0	11.9	2.0	11.0	nnw.	34	nw.	24	9	6	13	6.0	50
Valentine	2,598	46	54	922.5	1,018.3	−1.7	33	8	20.6	−.8	58	23	−10	3	1,240	1	70	T	−.6	T	0	0	T	1.0	9.1	w.	29	nw.	9	8	13	7	5.1	80
Sioux City[3]	1,138	5	40	978.3	1,020.6	+.6	26	5	15.8	−4.6	44	17	−17	4	1,382	11	78	.17	−.6	.09	3	0	1.9	3.0	11.2	nw.	35	nw.	9	9	6	13	5.9	60
Huron[3]	1,301	5	41	970.5	1,019.8	−.9	23	1	11.7	−2.6	48	23	−23	4	1,492	6	77	.09	−.4	.05	5	0	2.7	1.0	12.8	s.	40	se.	11	5	9	14	6.3	53
Northern Slope									16.3	−4.8							66	.59	.0														6.6	
Billings[3]	3,570	16	39	886.2	1,015.1	−5.6	29	6	17.4	−6.8	52	28	−24	13	1,333	6	58	.62	......	.31	6	0	10.1	T	12.4	sw.	41	e.	17	5	9	14	6.6	58
Butte	5,533	44	58	822.2	1,017.2	......	28	−2	13.1	−5.2	44	23	−40	13	1,451	7	75	.91	+.5	.37	11	0	19.7	8.0	9.6	s.	..	......	..	6	3	19	7.3	..
Glasgow	2,086	34	53	938.7	1,018.6	......	18	−9	4.4	−8.0	46	17	−25	6	1,698	4	67	.46	+.1	.16	9	0	5.0	5.0	......	......	..	......	..	5	11	12	6.5	..
Great Falls[3]	3,657	16	75	882.5	1,013.8	......	30	8	18.8	−6.5	57	28	−17	12	1,294	7	63	.79	+.2	.27	8	0	10.3	.0	16.0	sw.	61	sw.	17	6	7	15	6.5	68
Havre	2,507	11	67	923.8	1,018.3	−1.7	20	−6	7.4	−6.2	48	10	−22	6	1,612	......	..	.47	.0	.14	10	0	5.9	2.0	6.8	e.	32	nw.	10	3	11	14	7.0	52
Helena[3]	4,124	5	43	868.3	1,017.0	−2.6	26	3	14.4	−7.2	52	16	−19	13	1,412	6	69	.59	+.2	.39	7	0	11.2	T	7.8	nw.	73	w.	16	6	5	17	6.9	67
Missoula[3]	3,263	4	32	896.7	1,014.9	−4.1	32	11	21.4	−2.4	48	16	−15	13	1,220	16	81	.97	+.2	.21	14	0	12.5	1.0	5.2	wnw	37	nw.	8	4	2	22	7.8	40
Kalispell	2,973	48	56	906.2	1,013.5	−5.8	28	11	19.8	−3.5	48	23	−13	13	1,262	......	..	1.28	+.2	.26	17	0	14.6	2.0	5.0	w.	25	n.	11	5	5	18	7.4	34
Miles City[3]	2,371	5	28	929.2	1,019.1	−1.6	20	−6	7.1	......	48	17	−27	3	1,620	1	..	1.13	......	.50	6	0	19.0	12.0	8.0	sse.	..	......	..	3	11	14	7.1	..
Rapid City[3]	3,259	5	56	899.4	1,017.0	−2.3	30	5	17.6	−4.2	53	17	−13	13	1,329	8	70	.12	−.4	.08	5	0	1.3	2.0	14.1	nnw.	52	nw.	11	8	8	12	6.0	74
Cheyenne[3]	6,094	22	40	805.6	1,015.4	−2.6	38	13	25.4	−1.9	55	22	−16	13	1,108	10	53	.04	−.6	.04	1	1	.5	T	17.5	w.	52	w.	16	8	12	8	5.2	66
Lander[3]	5,352	6	30	823.9	1,017.3	−2.3	30	6	18.2	−4.3	50	17	−28	13	1,308	7	57	.39	−.2	.27	3	0	4.7	2.0	8.5	sw.	63	sw.	10	7	12	9	5.6	74
Sheridan[3]	3,790	5	38	873.4	1,016.2	−3.4	32	4	17.9	−4.7	56	17	−31	13	1,317	6	63	.41	−.3	.24	5	0	8.1	T	9.4	wsw.	54	sw.	16	6	9	13	6.2	56
North Platte[3]	2,821	11	51	917.0	1,019.0	−.6	36	14	24.8	−1.8	58	22	−4	13	1,127	16	74	.14	−.4	.14	1	0	2.0	T	9.1	w.	34	n.	11	8	11	9	5.7	66
Middle Slope									34.2	−.2							71	.96															5.3	
Denver[4]	5,292	106	113	832.4	1,014.9	−2.4	45	22	33.6	+.9	66	22	2	1	879	11	50	.10	−.4	.05	2	0	1.5	.0	7.3	s.	35	nw.	14	13	9	6	4.1	78
Pueblo[3]	4,690	5	36	849.6	1,015.6	−1.0	50	16	33.2	+1.1	68	22	−4	2	891	13	50	.17	−.3	.13	3	0	2.8	.0	8.8	w.	56	sw.	11	16	4	8	3.8	72
Concordia	1,392	50	58	968.5	1,020.3	+.3	35	20	27.4	−2.4	58	23	5	13	1,054	21	77	.61	−.3	.49	4	0	2.7	.0	8.3	sw.	21	s.	7	9	5	14	6.1	48
Dodge City[3]	2,509	5	58	924.5	1,018.6	−.7	41	24	32.2	−1.0	67	23	5	13	921	26	81	1.01	+.2	.27	7	1	3.9	T	15.4	s.	57	n.	5	8	4	16	6.6	42
Wichita[3]	1,358	52	64	968.2	1,020.0	+1.0	41	25	32.8	−1.6	62	18	10	13	899	26	77	1.80	+.6	.88	9	2	2.1	.0	13.8	s.	46	s.	7	11	2	15	6.1	52
Oklahoma City[4]	1,214	10	47	972.2	1,018.8	−.2	50	32	40.6	+1.0	67	19	16	1	681	33	80	.56	−.6	.25	9	4	.2	0	9.0	s.	26	s.	11	12	5	11	5.0	58
Tulsa[3]	674	10	60	995.3	1,020.4	......	40	30	39.6	+.5	67	19	8	1	715	33	79	2.46	+1.0	.99	10	2	2.4	.0	10.7	s.	37	s.	11	13	3	12	5.2	59
Southern Slope									46.6	+.9							72	2.23															5.8	
Abilene[3]	1,755	4	59	956.0	1,018.4	+.1	60	37	48.4	+2.4	74	21	18	1	463	38	73	1.04	.0	.72	5	2	T	.0	11.1	n.	47	s.	12	9	5	14	5.9	53
Amarillo[3]	3,604	5	42	891.3	1,017.1	−.2	50	29	39.2	+3.1	69	21	16	1	724	30	74	.59	−.1	.25	5	1	.3	T	15.2	sw.	37	sw.	10	11	5	12	5.1	64
Del Rio	960	63	71	983.1	1,017.2	−.1	66	50	58.2	+2.2	82	13	28	1	211	47	74	7.82	+7.3	5.06	6	2	.0	.0	8.1	se.	27	n.	14	3	7	18	7.7	31
Roswell	3,614	6	29	891.6	1,016.8	+.2	58	29	43.2	+.7	74	18	0	1	612	27	59	.42	−.2	.34	4	1	T	.0	7.7	s.	42	nw.	14	12	6	10	4.5	67
Wichita Falls	1,030	4	49	982.1	1,019.7	......	54	34	44.0	−3.7	71	12	15	1	581	36	79	1.28	.0	.81	8	3	T	.0	......	n.	..	......	..	9	6	13	5.8	..
Southern Plateau									44.6	−3.0							51	.41															4.4	
El Paso[3]	3,916	35	85	883.3	1,015.7	−.2	61	36	48.2	−.4	74	24	22	1	473	26	44	.22	−.2	22	2	0	T	0	8.9	nnw.	36	w.	14	17	2	9	3.8	81
Albuquerque[3]	5,314	5	45	836.8	1,016.7	+1.1	50	25	37.2	−3.3	66	22	10	1	777	18	50	.29	.0	.16	3	1	2.4	1.0	9.2	nnw.	38	s.	12	11	7	10	5.0	67
Flagstaff	6,907	34	48	787.7	1,020.1	+4.2	39	8	24.0	−6.8	57	23	−15	14	1,150	14	65	1.64	−.4	.50	10	0	26.9	15.0	5.6	nnw.	..	......	..	8	7	13	5.8	..
Phoenix[4]	1,107	39	87	977.3	1,017.2	+.9	66	40	52.8	−2.3	82	22	28	1	341	32	53	.08	−.7	.04	2	0	.0	.0	5.9	e.	25	w.	27	13	7	8	4.4	81
Tucson[3]	2,555	5	39	926.9	1,016.5	+1.6	64	36	50.2	−2.0	80	22	25	2	414	26	45	.20	−.8	.09	4	0	T	.0	7.6	se.	30	e.	10	15	4	9	4.1	80
Yuma	142	9	54	1,009.8	1,017.3	+.7	69	42	55.2	......	84	23	33	1	277	30	..	.02	......	.02	1	0	.0	.0	6.3	nw.	29	nw.	24	17	7	4	3.1	89
Middle Plateau									23.4	−8.8							72	.46	−.5														6.7	
Ely[3]	6,262	8	41	806.0	1,021.0	......	31	−1	15.0	−11.6	44	22	−25	13	1,400	......	..	.48	−.5	.30	5	0	11.1	7.0	12.9	s.	49	se.	11	7	7	14	6.5	60
Reno[3]	4,527	20	52	864.5	1,017.6	−1.0	45	16	30.2	−5.5	60	17	−5	13	976	20	68	.32	−.9	.11	8	0	8.1	.0	7.3	s.	56	s.	10	6	9	13	6.1	59
Winnemucca	4,339	5	56	865.6	1,016.9	−2.7	40	17	28.6	−4.9	55	28	−12	1	1,020	......	..	.45	−.5	.17	11	0	7.4	.0	9.9	sw.	42	sw.	6	6	4	18	7.0	51
Salt Lake City[3]	4,357	32	58	870.3	1,019.4	−.2	33	13	22.8	−9.3	47	21	−10	3	1,183	17	77	.64	−.6	.44	7	1	10.3	2.0	10.0	sse.	36	se.	11	3	6	19	7.7	56
Grand Junction[3]	4,602	5	26	852.4	1,023.5	+6.2	32	9	20.3	−12.6	48	27	−10	6	1,252	13	70	.40	−.2	.14	9	0	5.0	T	4.0	wnw	29	s.	12	6	10	12	6.0	64
Northern Plateau									28.9	−3.4							77	2.16	+.3														7.5	
Baker[4]	3,471	36	54	......	......	......	36	19	27.6	−1.4	50	27	−5	13	1,051	20	..	1.20	.0	.75	12	0	17.2	.0	6.9	se.	33	s.	10	7	5	16	6.9	41
Meacham	4,056	7	28	871.0	1,013.8	......	35	20	27.5	......	54	28	−3	13	1,047	22	83	6.71	......	1.85	20	0	62.0	52.0	9.1	se.	..	......	..	4	1	23	8.3	..
Boise[3]	2,739	5	49	918.4	1,016.9	−4.1	39	22	30.7	−2.9	50	22	−1	2	960	24	76	2.05	+.6	.82	13	0	25.2	.0	12.1	se.	40	nw.	4	4	6	18	7.3	44
Lewiston	1,436	4	23	960.4	1,012.7	......	41	26	33.6	......	54	28	10	13	877	26	74	1.20	......	.55	13	0	7.6	.0	8.1	e.	..	......	..	4	3	21	8.1	..
Pocatello[3]	4,478	5	31	860.5	1,018.4	−1.9	35	16	25.6	−1.3	50	27	−17	13	1,099	17	70	.85	−.4	.24	12	0	12.0	.0	14.6	ssw.	49	sw.	7	3	9	16	7.3	53
Ellensburg[3]	1,735	5	58	949.5	1,014.0	......	34	12	23.4	−7.6	49	16	−13	13	1,167	19	84	1.17	+.2	.35	12	0	19.0	7.0	8.2	e.	..	......	..	1	13	14	7.6	..
Spokane[3]	1,929	6	51	942.8	1,013.0	−6.3	35	18	26.4	−4.9	54	28	−4	1	1,078	21	79	3.08	+1.3	.77	13	0	18.7	T	9.7	ssw.	54	sw.	16	3	10	15	.73	45
Walla Walla	991	57	65	977.7	1,014.3	−5.3	43	28	35.6	−1.5	60	10	13	12	824	28	..	2.21	+.4	.72	12	0	8.9	.0	6.8	s.	30	sw.	17	2	6	20	.82	24
Yakima[3]	1,076	4	54	973.9	1,013.8	−5.2	43	16	29.7	−4.3	60	27	−7	5	987	22	75	1.01	+.1	.29	11	0	16.5	.0	7.5	wnw	58	wsw.	16	4	10	14	6.9	..

See footnotes at end of table

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR FEBRUARY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Total heating degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Precipitation: Days with 0.01 inch or more	Precipitation: Days with thunderstorms	Precipitation: Total snowfall (unmelted)	Precipitation: Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Wind: Speed of fastest mile: Miles per hour	Wind: Speed of fastest mile: Direction	Wind: Speed of fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover, [7] tenths (sunrise to sunset)	Possible sunshine
NORTH PACIFIC COAST	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F.	°F.	°F.		°F.		°F.	°	F.%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
									39.0	−1.7							83	7.55	+2.1														7.9	
Kelso [3]	750	38	76				46	30	38.3		67	27	14	13	749	34	87	10.43		3.06	21	0	16.7	.0	8.0	sse.				2	5	21	8.0	
North Head	211	5	55	1,004.4	1,012.2	−5.1	45	36	40.4	−2.6	64	25	27	13	684			10.31	+2.9	2.64	21	0	5.9	.0	17.6	w.	69	s.	5	2	7	19	8.4	29
Seattle [4]	125	90	321	1,007.1	1,011.8	−5.8	45	34	39.8	−3.0	65	28	23	13	704	33	82	6.82	+2.9	1.94	17	0	10.4	.0	11.6	s.	45	s.	16	3	8	17	7.7	30
Tacoma	194	172	201	1,005.1	1,012.2	−5.8	45	33	39.0	−1.6	64	28	21	13	723			6.40	+1.7	1.73	18	0	10.8	.0	10.1	s.	44	sw.	16	3	8	17	7.5	33
Tatoosh Island	86	5	61	1,007.1	1,010.2	−5.7	43	35	38.8	−2.2	53	25	27	12	729	34	85	10.58	+1.1	3.38	21	0	9.3	.0	18.3	e.	58	s.	21	3	6	19	8.0	30
Burns	4,162	35	47	860.3	1,015.2		37	18	28.0	−.6	50	25	−6	13	1,038	21	74	.87	−.4	.33	12	0	10.4	.0						6	5	17	7.0	
Eugene [3]	433	4	35	1,001.0	1,015.2		48	34	41.4		63	25	22	7	660	38	89	9.73		2.65	19	0	4.8	.0	10.0	s.				3	5	20	8.2	
Medford [3]	1,329	29	58	968.5	1,017.6	−1.0	49	30	39.6	−2.7	66	24	20	5	714	33	82	2.53	+.5	1.03	10	0	9.8	.0	5.2	n.				2	3	23	8.7	
Portland, Oreg. [4]	154	68	106	1,007.8	1,013.9	−4.4	47	36	41.4	−.7	63	26	25	13	662	34	85	11.43	+6.1	2.67	21	0	11.6	.0	7.2	s.	26	s.	9	6	1	21	7.5	33
Roseburg	510	45	76	997.6	1,016.6	−2.4	50	36	43.0	−.4	66	25	25	13	612	37	78	6.43	+1.9	1.63	19	0	10.5	.0	4.4	sw.	18	s.	21	3	5	20	8.2	18
MIDDLE PACIFIC COAST																																		
									46.5	−3.2							76	3.20	−1.1														7.0	
Eureka	60	72	88	1,017.3	1,019.6	+.3	51	40	45.6	−1.6	63	21	29	13	544			6.09	−.4	1.54	16	1	T	.0	7.9	s.	26	sw.	22	1	4	23	8.6	38
Red Bluff [3]	353	5	26	1,005.8	1,018.8		55	36	45.5	−3.9	73	27	23	2	547	34	70	1.77	−2.2	.48	10	1	2.5	.0	8.3	wnw	47	se.	6	8	5	15	6.4	54
Sacramento [4]	66	92	115	1,019.0	1,020.0	+1.4	55	38	46.6	−3.5	66	21	26	13	514	37	76	1.91	−1.1	.60	10	0	T	.0	6.8	s.	24	se.	6	7	7	14	6.3	47
San Francisco [4]	155	112	132	1,019.6	1,020.3	+1.7	53	43	48.3	−3.9	61	21	37	12	467	41	81	3.04	−.8	1.10	11	0	.0	.0	7.5	w.	29	sw.	6	7	7	14	6.7	42
SOUTH PACIFIC COAST																																		
									50.8	−2.8							70	1.32	−.9														5.5	
Fresno [2]	327	5	34	1,009.5	1,020.6	+1.3	59	36	47.2	−3.1	73	22	24	13	499	37	71	.73	−.7	.28	9	0	T	.0	4.5	nw.	29	nw.	11	10	4	14	5.8	64
Los Angeles	338	236	263				62	44	52.6	−2.9	78	22	34	14	348			1.41	−1.7	.46	5	0	.0	.0	6.6	wnw	26	nw.	7	10	4	14	5.7	64
San Diego [3]	87	20	55	1,017.6	1,019.4	+1.4	61	44	52.7	−2.4	74	17	36	15	344	52	70	1.81	−.2	.60	12	0	.0	.0	5.9	w.	26	sw.	7	12	6	10	4.9	58
WEST INDIES																																		
San Juan, P. R.	82	9	54	986.1	1,018.0		77	70	73.6	−1.3	80	24	67	1	0			1.66	−1.1	.39	17	0	.0	.0	16.0	e.	40	e.	14				5.8	61
PANAMA CANAL																																		
ALASKA																																		
Anchorage [2]	132	6	44	1,007.1	1,012.2		17	−5	6.0	−12.6	35	27	−27	9	1,653	0	67	.69	.0	.37	5	0	12.4	21.0	4.8	ne.	38	nw.	9	11	5	12	5.4	
Annette Island	113	5	53	1,002.7	1,006.8		36	25	30.1	−6.1	52	25	11	18	976	24	76	6.45	−.3	1.14	17	0	12.9	.0	13.3	se.				6	3	19	7.2	
Barrow	29	5	27	1,022.0	1,022.7		−13	−26	−19.6		13	12	−51	16	2,369	−24	64	.08	−.1	.04	4	0	1.1	15.0	11.7	ne.	38	w.	1	14	8	6	4.1	
Bethel [2]	28	5	31	1,012.9	1,014.2		11	−8	1.2		33	11	−33	9	1,787	−2	80	1.22	+.4	.41	9	0	11.3	32.0	11.0	n.				8	10	10	6.0	
Cordova [2]	45	5	32	1,005.4	1,007.1		27	2	14.9	−10.9	45	25	−16	19	1,406	13	80	2.56	−2.3	1.03	14	0	22.7	23.0	5.2	n.	29	n.	9	12	4	12	5.2	
Fairbanks [2]	455	5	63	999.0	1,017.8		4	−22	−9.0	−7.8	29	28	−46	10	2,076	−14		1.12	+.7	.72	8	0	16.9	24.0		n.	26	sw.	1	15	0	13	4.9	
Galena	139	4	66	1,011.5	1,016.6		1	−22	−10.6	−9.5	23	1	−48	9	2,116	−16	62	.61	−.1	.14	9	0	7.3	39.0		n.	26	se	10	8	5	15	6.1	
Gambell	32	5	32	1,013.2	1,014.2		11	0	5.7	+2.8	32	10	−17	7	1,660	2	84	.45	−.4		12	0	4.5	19.0	18.2	ne.	56	se.	10	2	2	24	8.4	
Juneau [2]	80	6	30	1,008.5	1,009.5		25	8	16.2	−11.3	41	26	−12	20	1,365	10	70	2.04	−2.2	.42	12	0	39.6	10.0		n.	28	se.	12	8	5	15	6.5	
Kotzebue [2]	20	5	31	1,015.9	1,016.6		2	−13	−5.6	−1.7	18	28	−34	9	1,978	−10	76	.33	+.1	.12	8	0	3.3	20.0	15.8	se.	57	se.	10	9	2	17	6.3	
McGrath [3]	341	5	31	1,002.7	1,016.6		5	−22	−8.4	−11.6	32	11	−43	17	2,055	−16	56	.70	−.6	.48	7	0	11.4	35.0		nw	23	sw.	11	7	3	18	7.1	
Nome [2]	22	10	75	1,013.5	1,014.2		10	−9	.8	−4.8	29	11	−42	8	1,800	−2	83	97	+.2	.32	12	0	9.7	67.0	11.1	e.	49	e.	10	4	7	17	7.2	
Northway [1]	1,718	5	32	951.9	1,020.0		−8	−34	−20.8	−14.0	23	28	−57	18	2,405	−27	65	.74	+.3	.59	5	0	7.4	32.0	2.5	e.				9	5	14	5.9	
HAWAII																																		
Honolulu [4]	38	86	98	1,015.9	1,016.6		76	67	71.6	+.8	79	21	63	2	0			5.81	+2.1	5.10	13	0	.0	.0	8.6	ne.	43	sw.	7	7	15	6	5.8	62

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations according to note 1.

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport; remainder from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined without necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

DELAYED REPORTS OF CLIMATOLOGICAL DATA FOR JANUARY 1949

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	54.3	+7.7	4 stations	85	[1]11	Madison	15	30	6.58	+1.51	Winfield	18.88	Robertsdale	2.09
Florida	64.8	+5.7	La Belle	89	29	2 stations	24	1	.88	−1.90	Chipley, 3 E	4.44	11 stations	.00
Georgia	55.6	+8.5	Millen	87	26	do	15	1	3.03	−1.27	Flat Top	16.55	Camp Stewart	.30
Mississippi	53.6	+6.4	5 stations	85	[1]10	Scott	7	31	8.69	+3.49	Houston	16.45	Biloxi	.66
North Carolina	50.3	+8.7	Henderson, 3S	81	25	Mt. Mitchell	3	1	2.83	−.94	Hyatt Creek	12.73	Elizabethtown	.93
South Carolina	54.3	+8.3	Calhoun Falls	85	12	Caesars Head	18	30	2.19	−1.36	Long Creek	10.04	Monck's Corner	.58
Tennessee	46.5	+7.4	Chattanooga, WB City.	79	12	Paris	6	30	8.43	+3.54	Lockhart Tower	14.90	Embreeville	1.56

[1] Other dates also.

SEVERE STORMS FOR FEBRUARY 1949

[The table hereunder contains such data as have been received concerning severe storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Idaho, most of State	1-15					Snow and wind	Frequent snows and high winds blocked roads and railways. Low temperatures aggravated conditions. Snowslides occurred at Anderson Dam from 7th to 10th, at Roland, Burke, and Wallace on 10th, at Forney (Blackbird Mine) on 7th and 11th ($10,000 damage to buildings), and at Palisades Dam on 11th (12 head of cattle lost). National Guard assisted in flying supplies into snowbound communities and in opening blocked roads. Red Cross also provided assistance to snow-bound areas, particularly in south-central portion of State (Magic Valley) which hardest hit of more populated areas. Little loss in lambing. Livestock losses generally small. Believe no human lives were lost. Snow removal, bursted water mains, and snow-slide damage to highway, utility, and railroad property, as well as damage to homes, estimated at $200,000 in vicinity of Wallace. No attempt made to estimate damage and cost of relief for State as a whole.
South Dakota	1-15					Semiblizzard	Considerable high winds and low temperatures unfavorable to livestock, weakened by January storms. Weather particularly severe on 8th, 9th, and 15th in northwest, and on 9th in central and southeast.
Montana	1-20					Snow and severe cold.	A continuation of extremely cold weather. Many cities had severe trouble because of freezing water mains. Frequent snows and blowing snows closed several main highways up to a week at a time.
Wyoming, central and southern portions.	5-19					Snow and blowing snow.	Continuous snow and blowing snow blocked all railroads and highways, causing suspension of transportation. All rail- and highways blocked with snow as fast as they could be opened. All transcontinental trains on Union Pacific suspended from 5th to 10th.
Watertown (near Lake City), Fla.	10	11:42-11:44 a. m.				Squall	High winds during cold front passage blew down trees and wire lines.
Jacksonville, Fla.	10	Noon-12:05 p. m.		1		do	During cold-front passage, small motorboat capsized in Trout River, drowning occupant. Maximum wind recorded at Weather Bureau office was 38 miles per hour for 5-minute period, with extreme of 50 miles per hour.
Hungry Horse, Mont.	10			1		Snowslide	Snowslide, resulting from rain, cost life of 1 workman.
Stillwater and vicinity, Okla.	12	7:45-8:10 p. m.	[1]3-4	0	$10,000	Tornadic	Path extended east-northeastward for about 4 miles. 2 persons injured slightly. 1 well-constructed farmhouse moved about 20 feet. Plate-glass windows in stores broken. Large trees uprooted. A few shed-type buildings demolished. Most of damage due to gustiness rather than unusually high velocity.
Pawhuska, Okla.	12	9 p. m.	[1]1		5,000	Wind	1 building partly blown down. Windows broken. Trees damaged.
Labette County, Kans.	12	9:30 p. m.	200	0	5,500	Tornado	Storm moved northeastward over path 9½ miles long. Damage to rural property near Edna. 1 barn demolished; other barns, sheds, and buildings damaged. No injuries. Apparently this tornado occurred in a squall line extending from Stillwater, Okla., to Crawford County, Kans.
Rock Island-Moline area, Ill.	12-13	Afternoon-morning.			2,000	Ice	Many utility wires broken. Numerous minor automobile accidents. Several persons injured in falls.
Victoria, Ill.	12-13	Afternoon-morning.			500	do	Telephone wires broken.
Nebraska, extreme eastern portion.	12-14		[1]20-50			Snow and sleet	Snowfall ranged from 4 to 13 inches; blocked roads and highways.
New Ross, Ind.	14	9:30 p. m.	230	0	600	Tornado	Moved southeastward; path 1,000 feet long.
Mississippi County, Mo.	14	11:30 p. m.	16	0	$13,500	Tornado and lightning.	Storm struck Hough Station and Big Lake vicinities, 5 to 7 miles northeast of Charleston. A number of dwellings, buildings and outbuildings damaged or demolished. 2 mules valued at $350 killed by lightning, which accompanied storm. Power lines broken and service disrupted. Some trees stripped of bark. 1 person seriously injured; several others injured slightly. Heavy rain accompanied storm. No crop damage.
Gibson and Pike Counties, Ind.	15	12:10 a. m.	440	0	50,000	Tornado	Moved eastward through Oatsville and Glezen; path 15 miles long.
Clallam County, Wash.	16	1-10 p. m.		1		Rain, slides, and floods.	Heavy rains caused flash floods in many localities and a sudden, severe crest in Pysht River. Earthslides resulted in places, blocking highways and demolishing buildings. Most roads in county blocked for a time by earthslides, isolating various towns and communities. At Port Angeles, an earth slide occurred at beach area, partially wrecking a dwelling and killing 1 person. Damage considerable.
Helena, Mont.	16				7,000	Wind	Several plate glass windows broken when gust of wind at 12:40 p. m. reached 73 miles per hour. Several roofs damaged.
Hungry Horse, Mont.	16				15,000	Snow and wind	A new 80 feet by 35 feet concrete masonry building collapsed.

[1] Miles instead of yards.

SEVERE STORMS FOR FEBRUARY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Shelby, Mont	16			1		Wind	Automobile blown off highway ½ mile south of Sweetgrass. 1 person killed and 1 injured.
Cut Bank, Mont	16-17				3,500	do	CAA radio range tower blown down and grainery unroofed. Damage to wheat in storage about $500, included in total.
Red Level (3 miles southwest), Covington County, Ala.	19	9 a. m.	100	0	8,000	Tornadic	A probable tornado moved eastward in a short path. 2 houses destroyed; 5 persons injured.
Seattle and Puget Sound area, Wash.	22					Earth slides	Following steady rains and a sudden ground thaw, earthslides developed on steep slopes at Seattle and at numerous points in Puget Sound area. Streets, highways, railroad property, and homes suffered occasional damage. North of Seattle, near Edmonds, 2 cars of a Great Northern passenger train derailed by mudslides. Property damage considerable. No injuries reported.
Superior and vicinity, Wis	23-24	5 p. m.-7 a. m.				Ice	Freezing rain and high winds caused considerable breakage in electric power and telephone lines. Electric and telephone service disrupted for several hours. Many tree limbs broken.
Sarasota, Fla	27	3 p. m.		0	1,000	Tornado	A small tornado passed northeastward 5 miles east of Sarasota. Length of path about ½ mile. Damaged garage, wrecked another, and moved small frame house off foundation. No injuries.
Baltimore, Md	28	1:30 p. m.				Wind	Woman suffered 2 broken wrists and a back injury when blown to ground by strong gusts. Winds of 35 miles per hour with highest gust of 65 miles per hour.
Cape Cod and Martha's Vineyard, Mass.	28	Afternoon and night.				Gales and snow	Heavy, wet snow froze on wires and trees, and combined with northeast winds of gale force caused considerable damage to power, electric, and telephone lines; many light and power failures.

LATE STORM REPORTS FOR JANUARY 1949

[The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Jackson County, Mo.	3	4-4:30 p. m.	440		$2,000	Wind and hail	Storm from Kansas struck Martin City and nearby vicinity. Damage mostly to roofs. Some small buildings overturned. Wind damage estimated at 75 percent and hail damage 25 percent of total.
Southern Kau district and Hamakua coastal area, Hawaii, T. H.	9					Wind and rain	Telephone and electric services disrupted; many poles down. Highways washed out in places, blocked in Kau district by fallen poles and wires.
Missouri, Newton and Jasper Counties to Marion, Ralls, and Pike Counties.	9-12		[1] 50-75		1,000,000	Ice	Storm moved eastward over State, except most of southeast. At many places, particularly in southwestern and central portions, storm was most severe of its kind on record. Damage mainly to communication and power lines and poles, and to trees and shrubs. Damage to lines of Southwestern Bell Telephone Co. alone estimated at $600,000 in Missouri. Ice on trees and wires accumulated to thickness of 1 to over 2 inches in places; Joplin, Bolivar, Columbia, and Fulton areas hardest hit. Many homes and industries were without heat, lights, or power. Many schools closed and all surface traffic seriously hampered, as roads and pavements became glazed with ice. Many persons suffered serious injuries in falls. A few fatalities indirectly as a result of storm. Very little crop damage, except severe to fruit trees. Many homes in harder hit areas still without telephone service at close of month.
Texas	9-13					do	Extensive glaze from 9th to 13th and 23d to 27th, affected area enclosed by a triangle drawn from Amarillo to San Antonio to Palestine, and back to Amarillo. Western Texas affected greatest from 9th to 13th, and northeastern Texas from 24th to 27th. Most damaging ice storm of record in Fort Worth-Dallas area. Very heavy damage to communication and power lines. 38 towns and cities without power and communication for some time. Damage described as "fantastic". Heavy damage to trees. Several radio stations forced off air, including WFAA, KRLD, WRR, KLIF, KSKY, and WBAP. Southwestern Bell Telephone Co. reported their damage to poles, lines, and equipment in Texas as $300,000. Other losses may exceed $2,000,000.
Hawaiian Islands, T. H.	16-17			2	125,000	Wind and rain	Damage to public utility poles and wires, highways, roofs, crops, and trees; scattered light to moderate losses over widespread general area. Local airline planes grounded. 2 persons killed on Kauai by landslide. Crop and property damage evidently heaviest on islands of Kauai and Oahu.
Missouri	18	During day				Ice	Storm moved northeastward over State. Glazing conditions rather general, especially destructive in St. Louis area. Freezing rain began before dawn and continued throughout day. Telephone and power lines, poles, and many trees broken or felled. Highways and roads hazardous, except in southeast. Many schools closed, particularly in St. Louis area. Many persons injured in falls on ice. Much damage also at Warrenton, Boonville, Lockwood, Marshfield, and Springfield. Minor to light damage in Birch Tree, Crane Mountain, and Crystal City areas. Accumulation of ice as much as 1 inch in some places.
Texas	24-27					do	(See remarks for ice storms of 9th-13th, same State.)
Missouri, central and southeastern portions.	25-27					do	Damage, locally, to trees, telephone, and power lines. All surface traffic seriously hampered by glaze. Many schools closed. Many persons injured in falls. St. Louis area and area around West Plains apparently hardest hit, but damage minor compared to 2 previous ice storms. In some places ice ¼ to 1 inch thick on wires and twigs.
Wisconsin, southern portion	27-28	Evening of 27th-28th.		1	10,000	Ice, sleet, and snow	Sleet and freezing rain were heaviest in Green, Kenosha, Milwaukee, Rock, and Walworth Counties. Principal damage to power and telephone lines. Many industries in Rock and Walworth Counties closed because of electric power lines being down. Farther north heavy snow, accompanied by strong winds. Main highways partially open, but all side roads blocked by drifted snow.

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR FEBRUARY 1949

Explanation of tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, volume 72, No. 1, January 1944, page 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in table 1 appears in volume 75, No. 3, March 1947, page 47.

An Eppley 180° pyrheliometer and Brown Electronik recording potentiometer were installed at the Weather Bureau office at Santa Maria, Calif., early this year. Similar equipment is now being operated at the Weather Bureau office at Oak Ridge, Tenn. Beginning with this issue, daily totals and weekly means of total solar and sky radiation received on a horizontal surface at these two stations will appear regularly in table 2.

The coordinates for Santa Maria are: Latitude 34°56′ N., longitude 120°25′ W., elevation 11.5 meters m. s. l., while at Oak Ridge they are latitude 35°55′ N., longitude 84°19′ W., elevation 220.55 meters m. s. l.

Obstructions to the free horizon at Santa Maria are limited to an anemometer pole and vane rising 45° above the horizon to the northeast, two antenna poles 1″ in diameter to the south and southeast, and a wind sock also in the southeast. No man-made obstructions create shading of the pyrheliometer at Oak Ridge but the station is surrounded by hills ranging in elevation from practically zero to the northeast to 14° above the horizon at Haw Ridge to the south-southeast.

TABLE 1.—*Solar radiation intensities during February 1949*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a.m.[1]	1:30 p.m.[1]
MADISON, WIS.											
	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
February	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
9						1.33				0.7	1.3
10	0.68	0.79	1.04	1.31		1.37				2.1	1.7
15	.71	.87	1.02	1.25						1.0	2.3
18	.79	.90	1.02	1.18		1.16				5.3	6.1
25						1.35				2.3	2.2
28	.95	1.10	1.21	1.35		1.33				.9	1.0
Means	.78	.92	1.07	1.27		1.31					
Departures	−.07	−.08	−.07	−.06		−.01					
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
February	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
8				1.61							
9	1.14	1.23	1.35	1.49							
17	1.21	1.29	1.39	1.52							
18				1.51							
25				1.47							
Means	1.18	1.26	1.37	1.52							
Departures	.00	−.01	−.01	+.01							

TABLE 1.—*Solar radiation intensities during February 1949*—Con.

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0	P. M.					
	78.7	75.7	70.7	60.0		60.0	70.7	75.7	78.7	7:30 a.m.[1]	1:30 p.m.[1]
BOSTON, MASS.											
	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	3.96	4.96		
February	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
2	0.80	1.01	1.15							2.0	2.0
8	.64	.74		1.05						3.1	3.6
9	.56	.64	.85	1.05						7.4	6.9
17						1.44	1.33	1.18	1.11	5.2	2.4
21		.93	1.09				1.11			2.4	3.2
23						1.19	.91	.60	.63	7.4	6.6
24	.50	.77	.99	1.16						3.9	4.0
Means	.65	.82	1.02	1.09		1.32	1.12	.94	.87		
Departures	+.01	+.04	+.13	.00		+.15	+.08	+.15	+.19		
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
February	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1				1.17		1.15	0.99	0.87	0.77	3.0	2.6
2	0.92	1.06	1.16	1.38		1.42	1.17	1.04	.95	1.6	1.5
6			.90	1.07						2.2	3.7
7	.74	.88	1.04	1.27		1.29	1.19	1.05	.97	4.8	8.0
11				1.21						3.3	2.1
17	.64	.80	.93	1.39		1.41	1.26	1.12	.90	5.4	1.8
21						1.32	1.12	1.00	.91	2.1	3.1
23						1.14	.95	.84	.71	7.2	6.3
27	.99	1.09	1.19	1.30		1.34	1.21	1.05	.94	2.4	2.9
Means	.82	.96	1.04	1.26		1.30	1.13	1.00	.89		
Departures	−.09	−.06	−.06	−.03		+.01	−.01	.00	−.01		
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
February	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1		0.85	1.09	1.31		1.31	1.13	0.96	0.83	1.0	1.7
8	0.72	.92	1.11	1.27						2.7	2.5
9	.62	.79	1.02	1.29		1.29	1.12	.99	.88	2.5	4.0
11	.81	.92	1.05	1.27						3.5	6.4
16	.92	1.02	1.15	1.29		1.29	1.13			2.6	2.7
17	.83	.96				1.29	1.09	.94	.83	4.2	6.1
18	.90	1.01	1.12	1.30						6.1	4.4
28	.87	.98	1.11	1.27						2.5	2.6
Means	.81	.93	1.09	1.29		1.30	1.12	.92	.84		
Departures	−.09	−.07	−.06	−.05		−.03	−.09	−.09	−.07		

*Extrapolated.

[1] 75th Meridian Time.

NOTE.—Figures in parenthesis are nterpolated.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface during February 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	La Jolla, Calif.	Riverside, Calif.	Santa Maria, Calif.	Inyokern, Calif.	Oak Ridge, Tenn.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Columbia, Mo.	Soda Springs, Calif.	Grand Lake, Colo.	New York, N. Y.	Salt Lake City, Utah	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Ithaca, N. Y.	Twin Falls, Idaho	East Lansing, Mich.	Madison, Wis.	Toronto, Canada	Summit, Mont.
1949	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Jan. 29	498	436	329	364	362	386	188	94	313	313	112	257	(325)	383	145	264	116	290	278	101	254	(286)	237	97	213	156	313	245	(86)
Jan. 30	517	402	316	318	372	377	101	113	317	305	194	283	368	245	254	107	260	286	299	314	258	300	249	197	204	234	305	245	120
Jan. 31	400	476	256	351	352	383	96	187	338	335	73	209	390	385	27	167	104	270	20	196	23	19	4	34	236	135	248	144	(200)
Feb. 1	473	346	298	292	231	374	311	264	305	292	296	342	87	375	260	223	223	301	279	326	243	281	230	148	276	225	333	160	216
Feb. 2	350	457	264	187	388	376	358	342	372	246	317	302	284	162	309	238	287	144	316	283	281	321	270	161	288	63	274	262	154
Feb. 3	377	429	187	128	366	397	158	91	277	272	293	45	215	272	240	166	262	121	300	99	264	297	238	155	132	204	51	83	166
Feb. 4	447	379	244	235	409	344	76	107	139	45	176	217	82	301	33	294	70	262	34	153	48	49	24	17	145	189	317	18	111
Means	438	418	270	268	354	377	184	171	294	258	209	236	250	303	181	208	189	239	218	210	196	222	179	116	214	172	263	149	139
Departures	+40	+30	−9	+16	-----	-----	-----	−10	+92	+58	+5	+24	−3	-----	+5	−4	+33	+25	+1	+41	−21	+6	−3	−41	+24	+21	+75	+9	+8
Feb. 5	364	368	241	138	288	404	307	130	310	353	264	147	(320)	123	232	330	207	89	259	292	181	202	149	106	244	198	289	241	(142)
Feb. 6	394	380	378	377	338	388	286	355	232	32	180	183	62	377	234	196	258	344	315	240	254	275	191	177	91	132	85	165	49
Feb. 7	79	55	84	90	377	365	358	377	205	329	270	394	230	107	128	201	330	319	23	346	30	40	16	158	268	251	302	201	(78)
Feb. 8	78	99	379	409	411	420	273	346	376	202	236	311	231	380	253	334	334	337	326	272	295	338	261	196	245	190	269	207	75
Feb. 9	177	235	358	390	423	418	125	90	382	220	191	378	369	230	223	245	266	352	252	320	226	269	236	88	197	263	329	207	122
Feb. 10	295	289	394	389	369	392	329	368	265	38	20	381	85	262	64	196	91	326	100	138	121	188	180	138	51	91	330	139	60
Feb. 11	587	494	253	227	220	379	392	396	188	322	365	363	(122)	196	344	172	385	334	326	334	293	291	242	172	231	274	271	299	(226)
Means	282	274	298	289	346	395	296	294	280	214	218	308	203	239	211	239	267	300	229	278	200	229	182	148	190	200	268	208	107
Departures	−107	−91	−21	−11	-----	-----	-----	+107	+22	−31	+6	+64	−61	-----	+35	−5	+96	+50	+8	+86	−14	+5	+2	−23	−7	+27	+62	+22	−18
Feb. 12	560	518	293	349	431	419	321	322	425	394	262	212	489	318	296	274	277	46	300	216	299	348	265	183	290	163	131	211	290
Feb. 13	558	532	105	231	443	413	297	90	450	395	156	30	440	341	156	346	117	260	254	105	227	164	107	5	347	46	102	108	112
Feb. 14	552	394	387	387	443	456	210	213	414	382	107	37	410	331	51	249	58	175	142	76	172	209	156	64	276	26	129	87	68
Feb. 15	506	520	359	304	439	422	34	34	396	193	239	393	100	201	202	181	70	402	227	51	203	99	43	69	282	60	410	57	162
Feb. 16	582	550	378	413	438	451	71	183	409	245	21	236	445	438	98	280	122	403	124	273	141	116	86	200	215	118	331	221	(30)
Feb. 17	457	425	393	408	440	452	388	420	412	385	369	423	447	410	395	362	398	392	380	344	360	400	364	84	316	272	330	282	39
Feb. 18	560	511	372	406	446	456	178	154	412	384	343	418	(452)	412	280	332	372	207	375	380	367	386	316	210	295	302	336	294	190
Means	554	493	327	357	440	438	214	202	417	340	214	250	398	350	211	289	202	269	258	206	253	246	191	117	289	141	253	180	128
Departures	+71	+62	+5	+34	-----	-----	-----	−16	+120	+51	−15	−10	+70	-----	+16	+19	+17	+12	+9	−25	+16	+6	−3	−66	+33	−67	+25	+13	−15
Feb. 19	505	373	68	389	365	460	33	41	415	384	81	216	480	459	223	331	186	109	289	272	295	301	267	168	354	208	143	132	137
Feb. 20	564	452	338	373	252	428	347	309	266	172	192	107	136	353	131	278	161	182	142	58	119	104	88	46	318	92	181	142	313
Feb. 21	494	515	392	369	445	431	291	216	416	294	56	70	432	282	350	366	123	180	371	169	216	343	274	217	311	69	49	128	48
Feb. 22	611	534	398	415	347	472	249	268	382	118	28	91	86	485	39	252	36	231	143	56	114	80	67	11	236	33	140	8	100
Feb. 23	503	435	202	307	181	401	428	348	191	111	376	271	352	482	306	342	375	100	390	150	343	349	260	96	334	96	287	95	(177)
Feb. 24	553	501	243	151	137	376	97	61	237	211	313	267	217	381	336	188	241	390	368	132	372	379	332	138	335	62	55	134	327
Feb. 25	568	436	372	252	414	479	452	330	274	333	220	452	484	448	80	77	45	389	64	52	52	46	32	17	373	98	376	60	33
Means	542	464	288	322	306	435	271	225	312	232	181	210	312	413	209	262	167	239	252	127	216	229	189	99	323	94	176	100	206
Departures	−4	−10	−46	00	-----	-----	-----	+2	+34	−68	−82	−48	−27	-----	−17	−32	−50	−40	−12	−102	−50	−39	−33	−112	+58	−103	−73	−36	−15
ACCUMULATED DEPARTURES ON FEBRUARY 25, 1949																													
	+56	−28	−2002	−980	-----	-----	-----	−476	+3906	+840	−1575	−1351	+28	-----	+98	−252	−21	−973	−1050	−812	−1645	−945	−847	−3304	+1281	−2023	−63	−168	−15

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflected from the ground, as received on a vertical surface facing south at Blue Hill, Mass., during February 1949*

Date	29	30	31	1	2	3	4	Mean	5	6	7	8	9	10	11	Mean	12	13	14	15	16	17	18	Mean
Gm cal/cm²			8	474	551	473	29	307	227	394	30	521	371	166	386	290	493	119	185	62	50	532	523	28
Date	19	20	21	22	23	24	25	Mean																
Gm cal/cm²	367	53	431	29	388	466	17	250																

EXPLANATION OF TRACKS OF HIGHS AND LOWS FOR MONTHLY WEATHER REVIEW

Beginning with the January 1949 issue Charts II and III, Tracks of Centers of Cyclones and Anticyclones, have been revised in several ways. Only those centers which have a history of at least 24 hours are used. The 7:30 a. m. positions are indicated by small open circles with the date above and the central pressure to whole millibars below. Intermediate positions are indicated as before by dots; however, they are now at 6-hourly intervals instead of 12-hourly. A dashed track indicates a regeneration rather than actual movement to the next position. Semipermanent features such as the Great Basin and the Pacific highs, Colorado and Mexico lows, are not shown. Data are taken from the North American sea level maps of the WBAN Analysis Center.

U. S. GOVERNMENT PRINTING OFFICE: 1949

Chart I. Departure (°F.) of the Mean Temperature from the Normal and Wind Roses for Selected Stations, February 1949

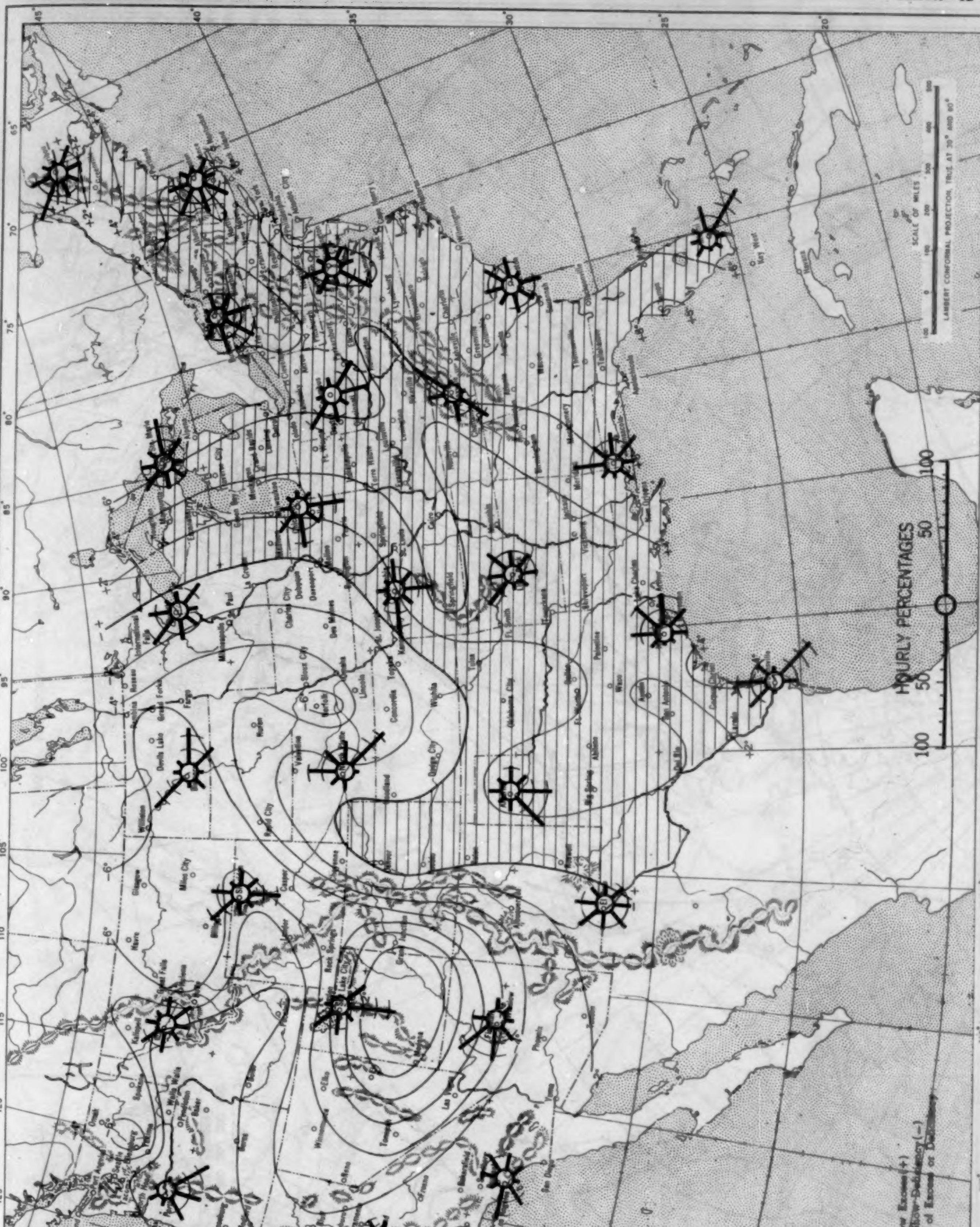
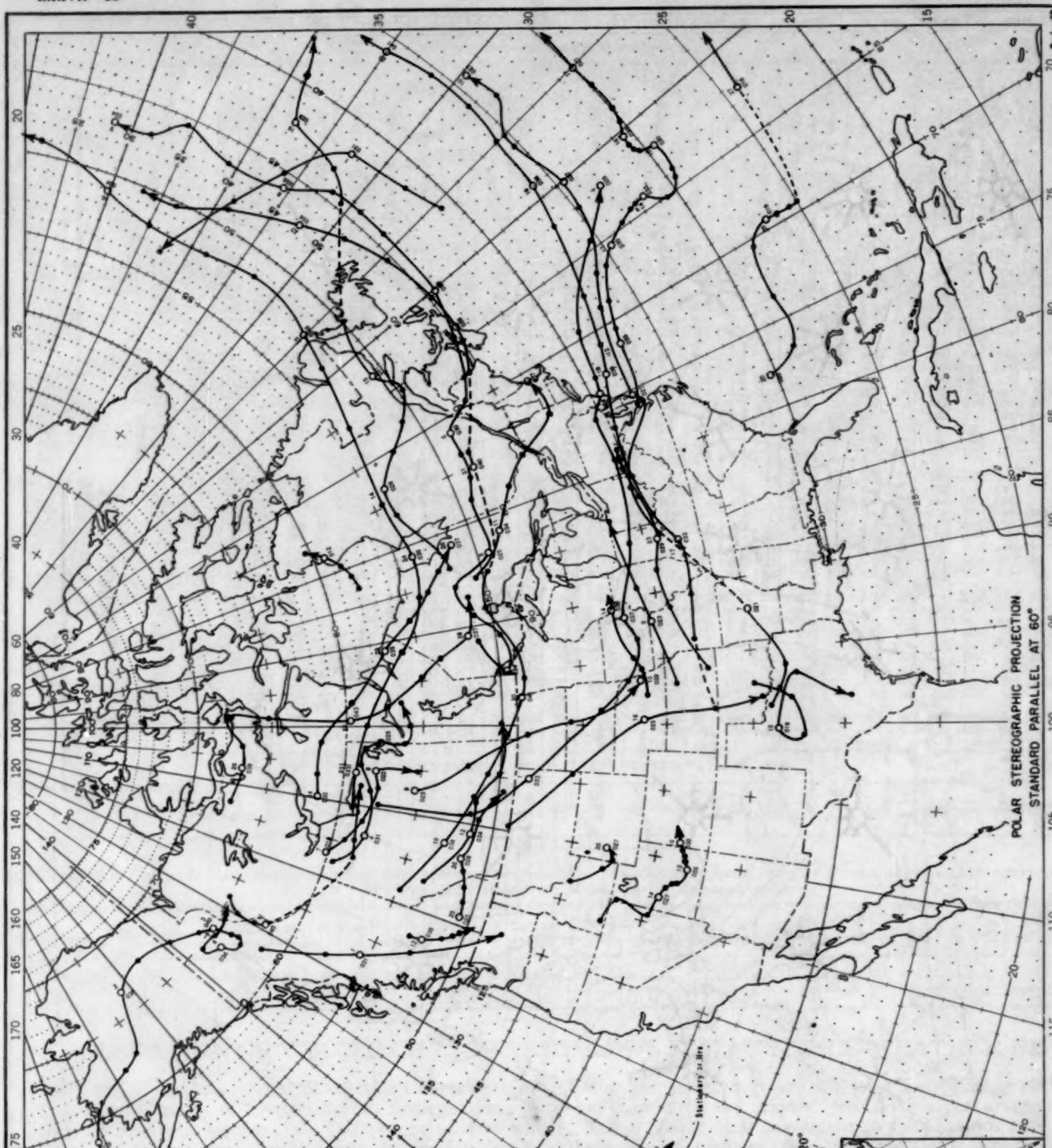
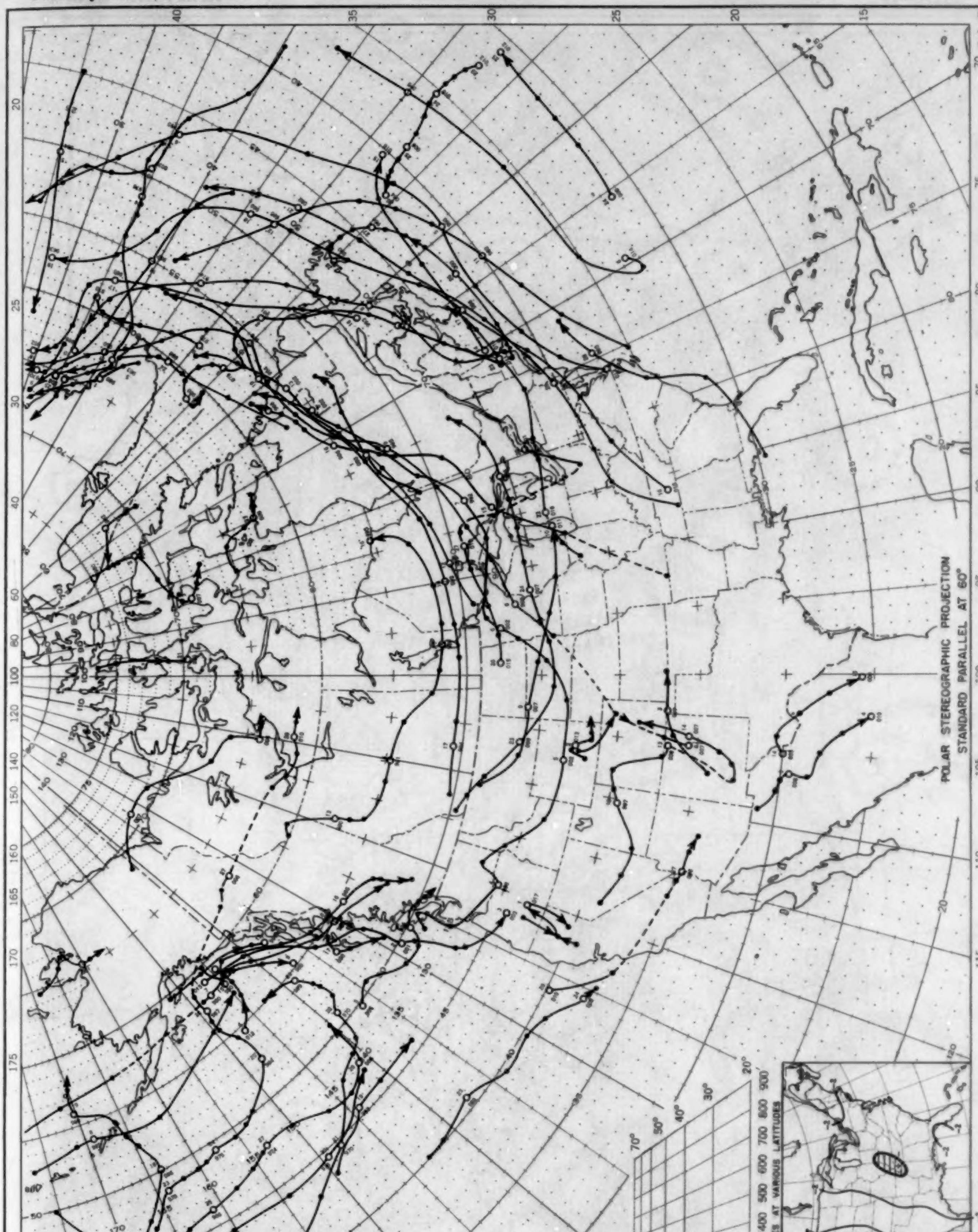


Chart II. Tracks of Centers of Anticyclones, February 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, February 1949. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, February 1949

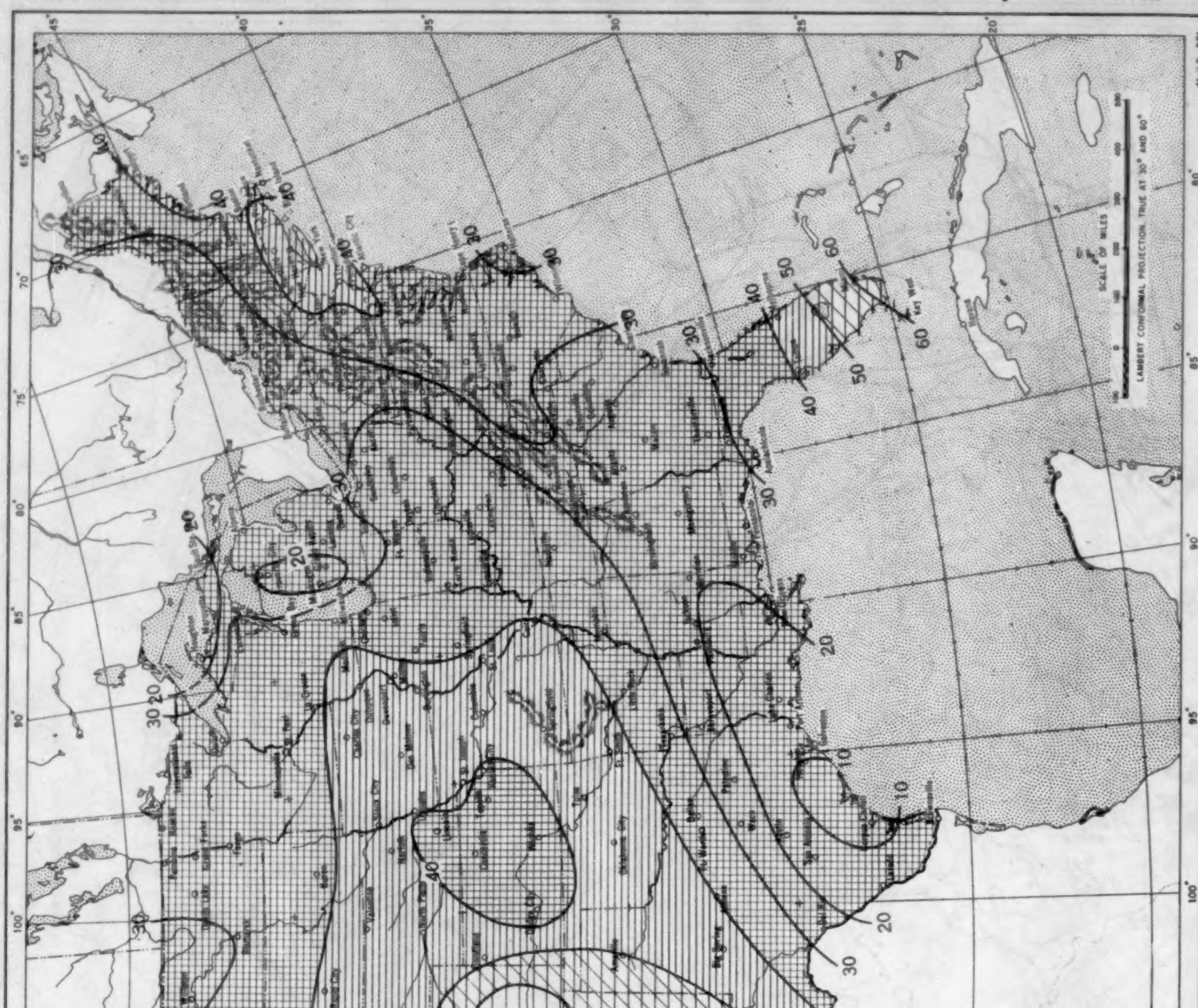


Chart V. Total Precipitation, Inches, February 1949. (Inset) Departure of Precipitation from Normal

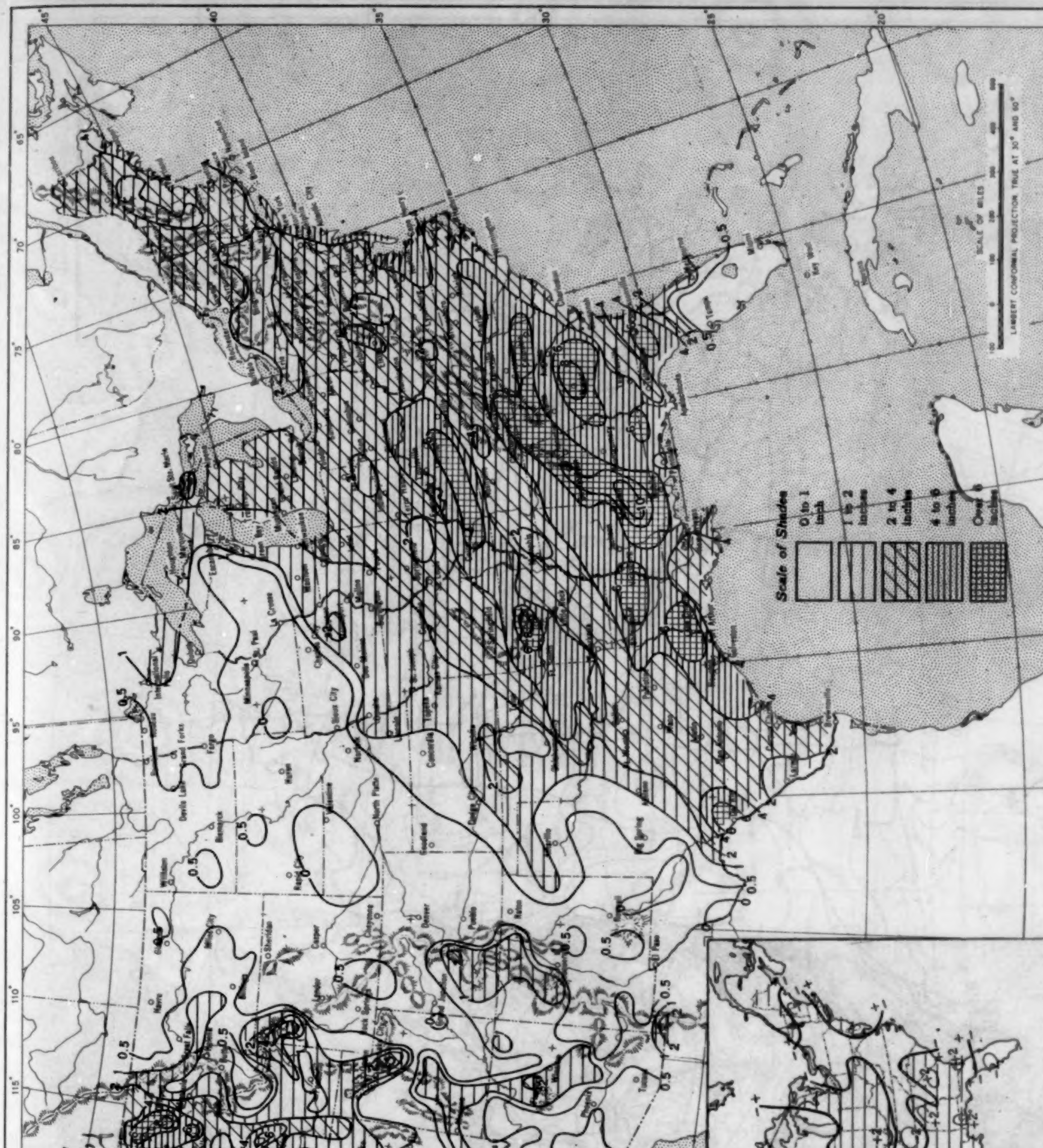


Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface; Prevailing Winds, February 1949

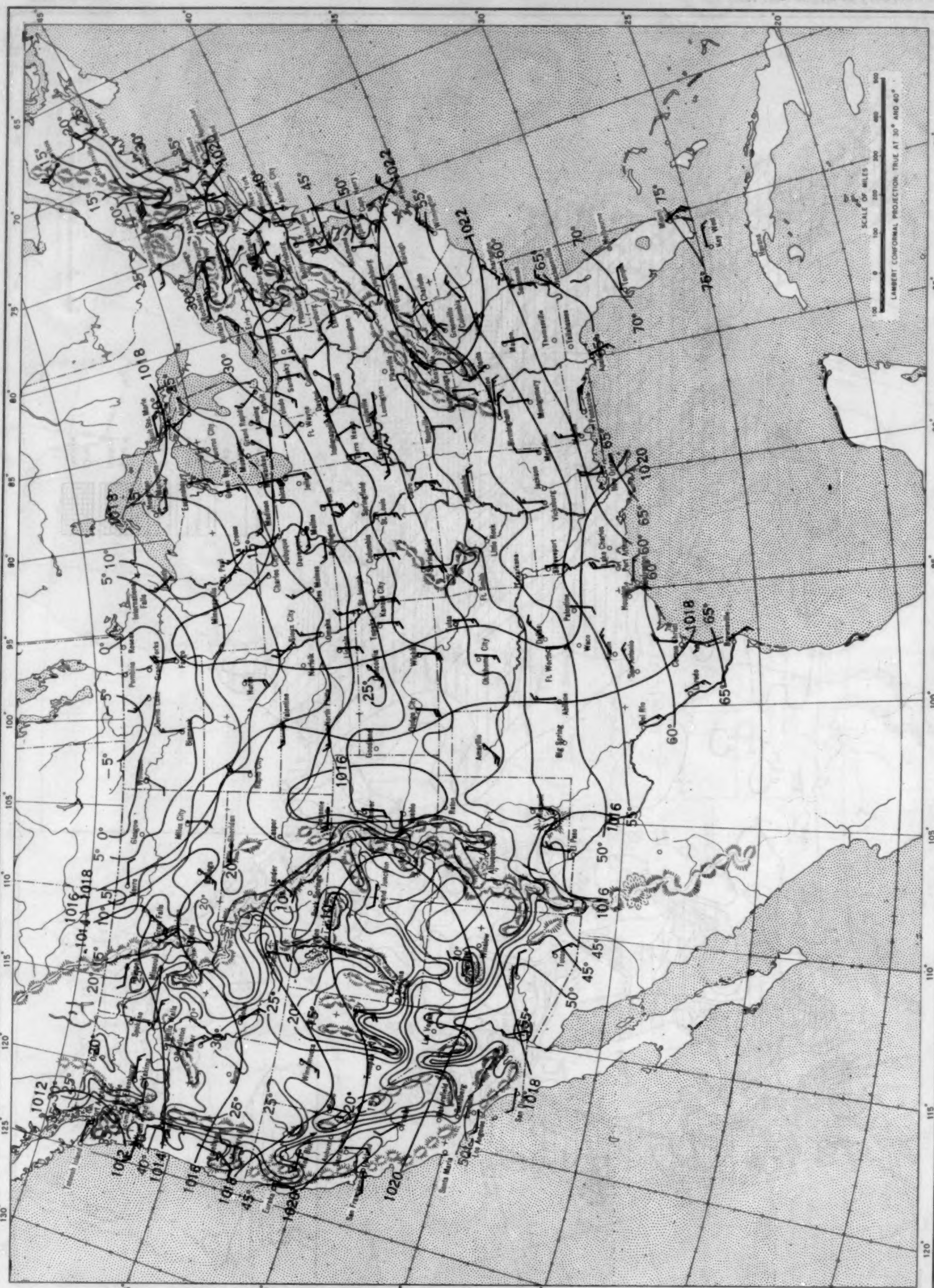


Chart VII. Total Snowfall, Inches, February 1949. (Inset) Depth of Snow on the Ground at 7:30 p. m., February 28, 1949

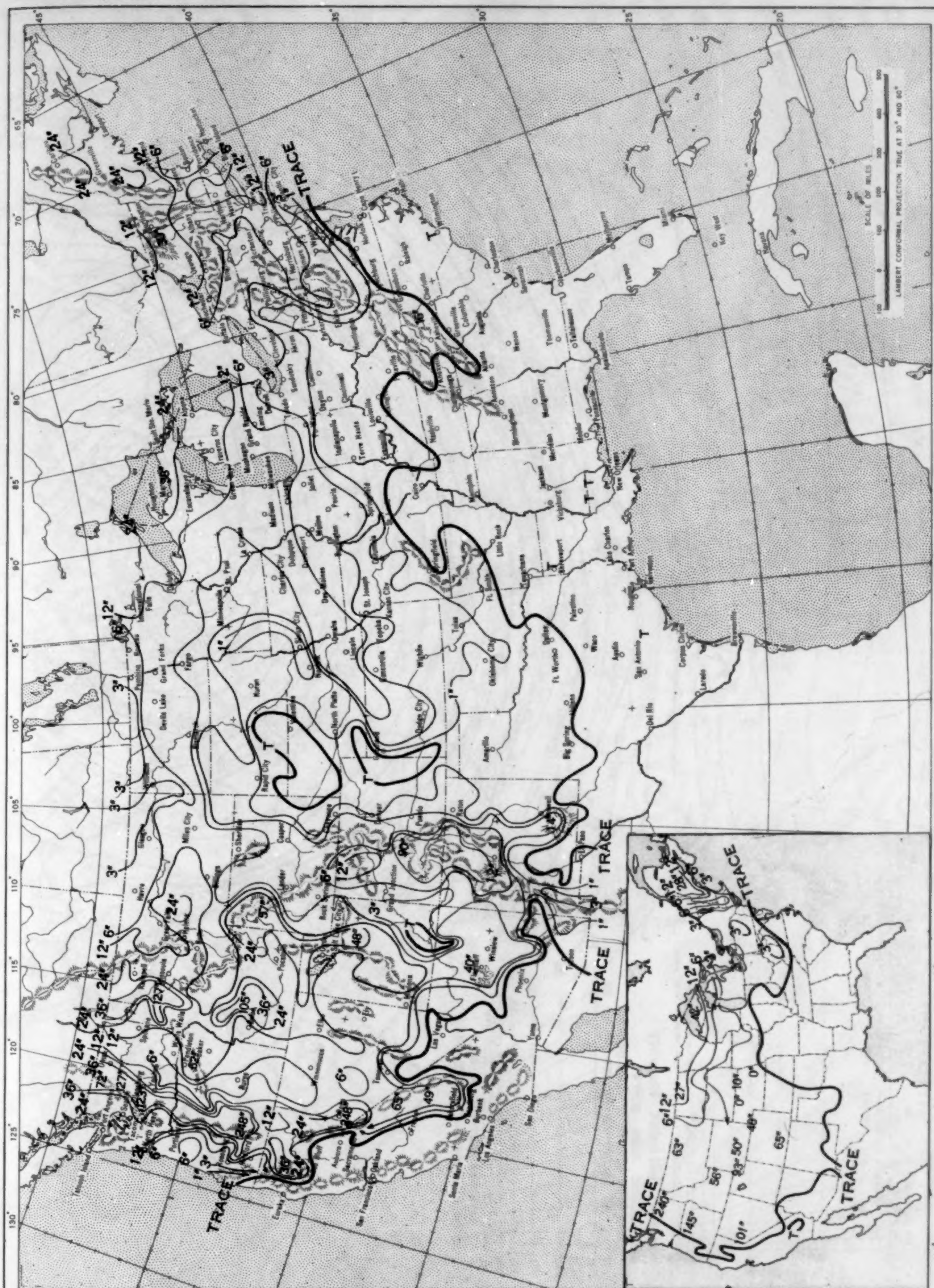
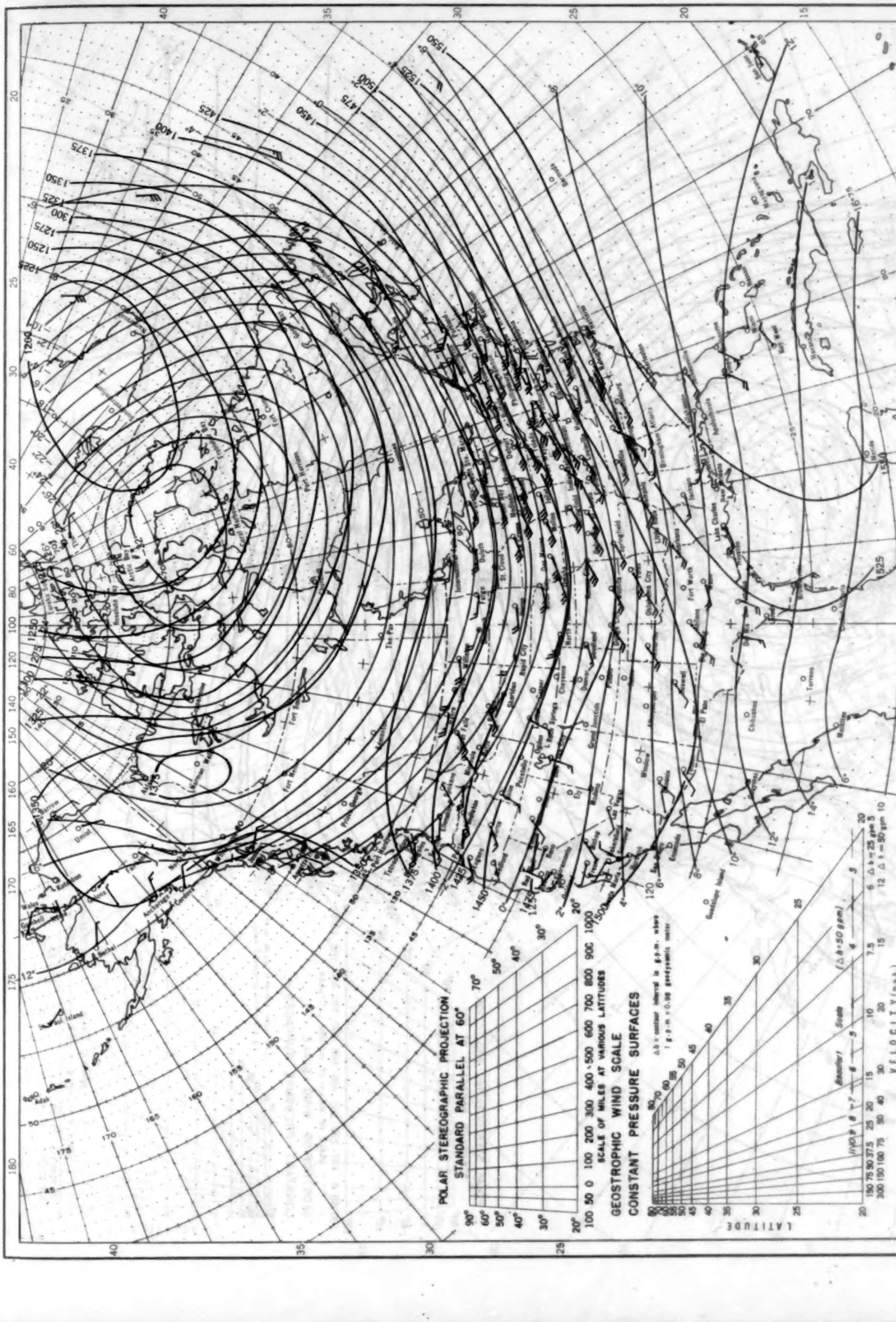


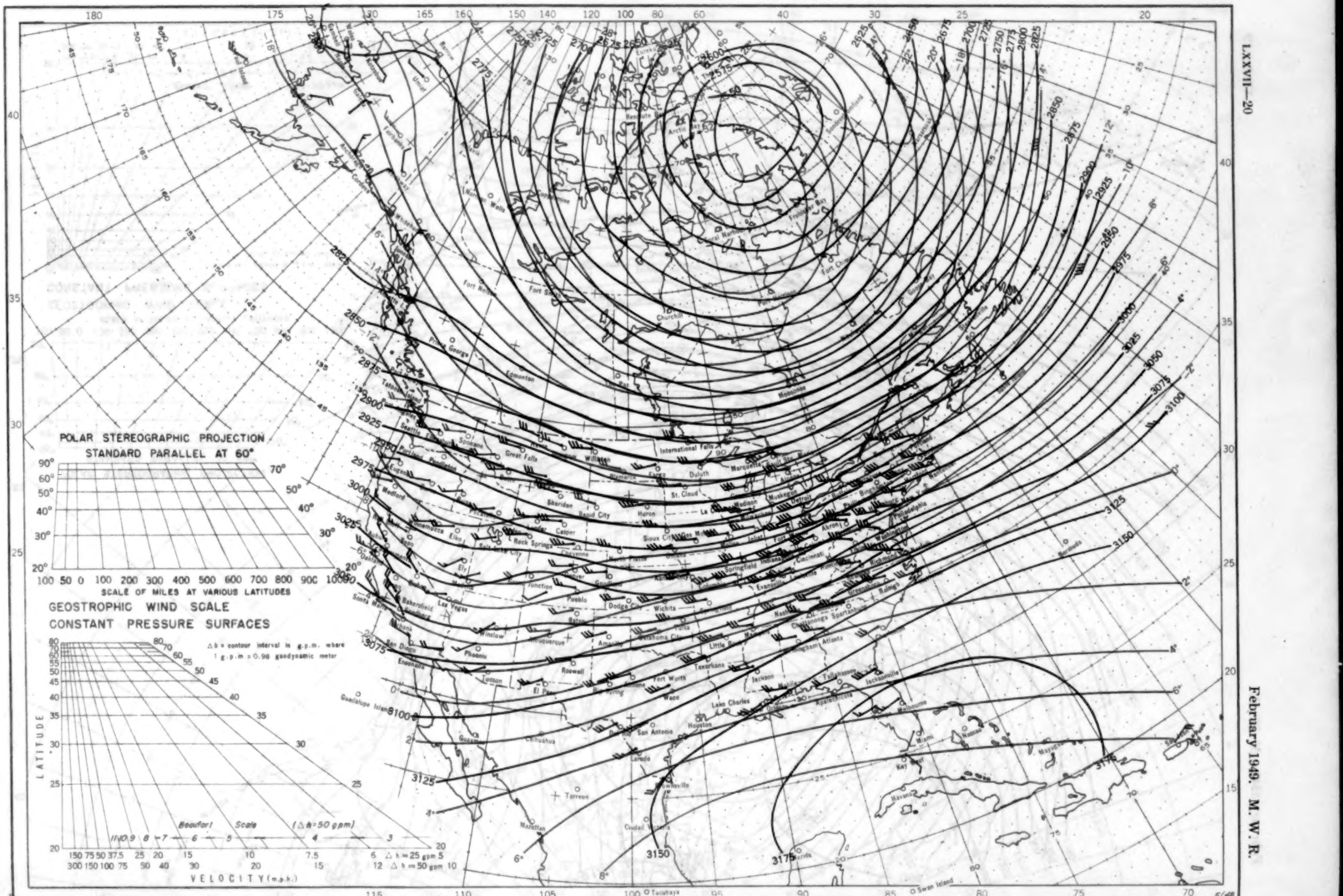
Chart VIII, February 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in

Chart VIII, February 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m.s.l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

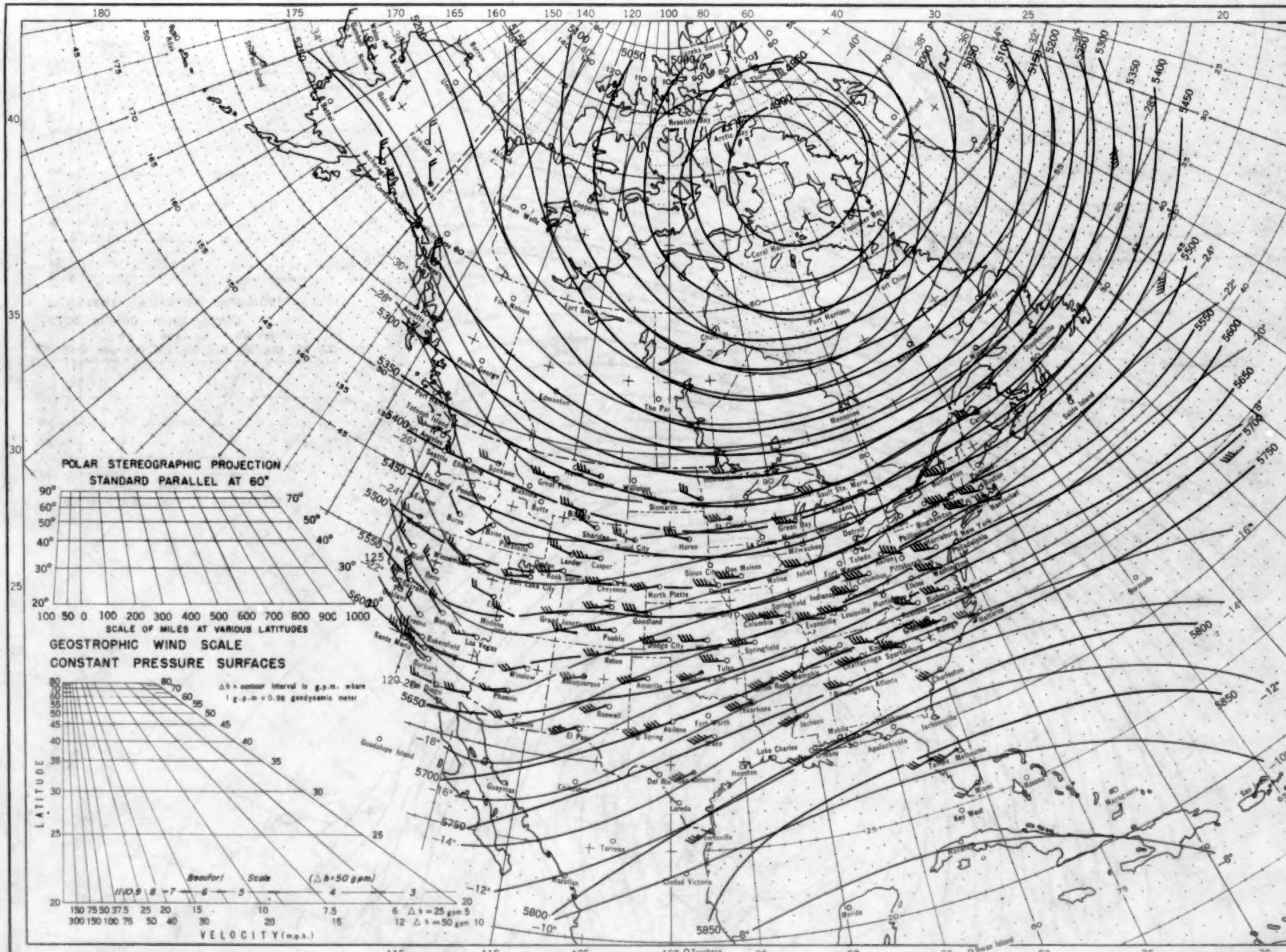
Chart IX, February 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

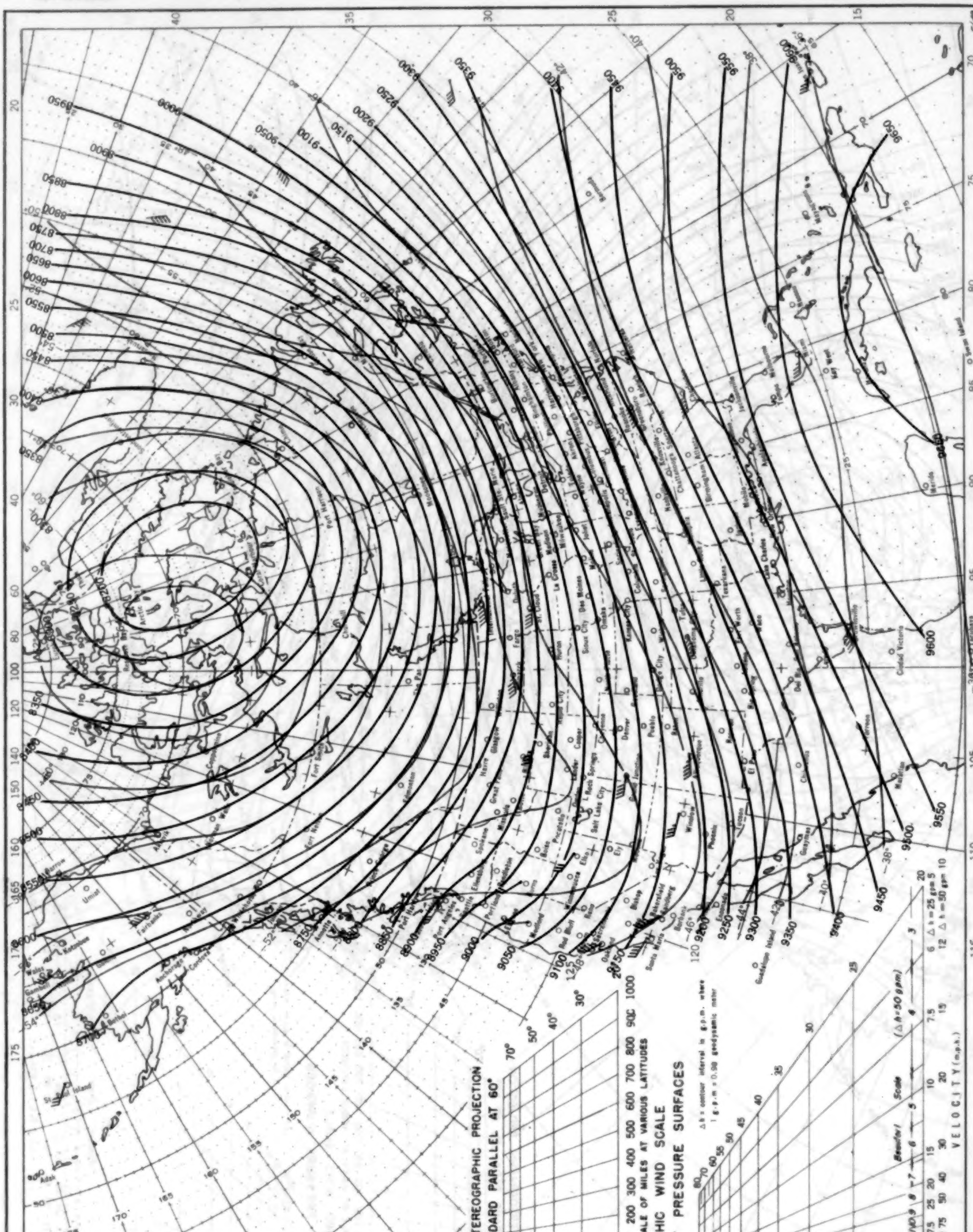
Chart X, February 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in

Chart X, February 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, February 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.